

ON THE
NATURE AND TREATMENT
OF
STOMACH AND RÉNAL DISEASES.

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OF
STOMACH AND RENAL DISEASES

BEING AN INQUIRY INTO THE CONNEXION OF DIABETES,
CALCULUS, AND OTHER AFFECTIONS OF THE KIDNEY
AND BLADDER, WITH INDIGESTION.

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THE FIFTH EDITION, REVISED.

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P R E F A C E

TO THE THIRD EDITION.

THIS edition has been rewritten, and the materials arranged on principles now for some years before the public. As these principles naturally include almost every disease to which organised beings are liable; with the view of familiarising them, and of rendering the different parts of the volume in some degree independent of each other, the leading points have been purposely repeated—a statement thus made at the outset, to obviate the charge of tautology.

The author, in presenting to the public the *results* of nearly thirty years observation and experience, has still kept in view, as much as possible, the *practical* character of his treatise. All chemical and physiological details, therefore, not urgently required, have been avoided. Such details may be given in a future volume. In the mean time, conscious of his fallibility and imperfections, the author invites the candid criticism of the *experienced* chemical pathologist, who alone is capable of appreciating his labours.

Sackville Street, September, 1840.

P R E F A C E

TO THE FOURTH EDITION.

THE present edition is essentially the same as the last. The chief alteration consists in the arrangement of the Introduction, which now constitutes a Third Book. As an introduction, this part of the volume was already too long; and as I could not add a few necessary remarks, without rendering it still more unwieldy, I was induced to make the change in question.

Since the third edition was published, Professor Liebig's treatises on Vegetable and Animal Chemistry have made their appearance, and attracted no little notice. Some of the views advanced by this distinguished chemist in his last work, are the same I have long advocated. Others of his views are directly opposed to mine, and seem to me to be neither susceptible of proof, nor even probable. The *practical* nature of this volume, however, precludes all controversy, particularly on matters of no *practical* utility; and I allude to the subject chiefly for the opportunity of observing, that having in the following pages stated my own opinions without reference to Professor Liebig, I leave it to the public to decide whether he or I have most nearly approached the truth.

There is another point also connected with this part of the subject which requires a few remarks. I have purposely omitted the

formulæ now so much in fashion among chemists, not only because I consider them clumsy and unphilosophical as conventional expedients, but because I am satisfied that very few, if any of them, represent the true constitution of organised substances. A grand clue to many chemical phenomena will be found among the multiple relations of what are termed the atomic weights of bodies. After nearly thirty years, chemists have reluctantly admitted the existence of such relations among the four constituent elements of organised bodies. Another generation, I have no doubt, will recognise and admit the important consequences to which these relations lead.

Sackville Street, June, 1843.

P R E F A C E

TO THE FIFTH EDITION.

In this edition, I have introduced such new facts as have come to my knowledge; and which, from their *practical* bearing, have more especially appeared worthy of notice.

I have still omitted the chemical formulæ now in fashion, because in general I do not deem them trustworthy. In a great many instances, before the truth can be known, chemists must work more, and speculate less.

Some late investigations have indeed been of a better character; and Physiology and Pathology will yet, I trust, derive those elucidations from chemistry, which this science, *legitimately applied*, alone can give.

Sackville Street, March, 1848.

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DESCRIPTION OF THE PLATES.

FOR the last twenty years or more, I have been in the constant habit of examining the various urinary deposites with high magnifiers, and with a compound microscope ; so that all the usual forms assumed by these matters have been long familiar to me. I am no draughtsman, and in the last edition of this work adopted the figures given by M. Rayer ; which in general accorded with my own observations. In the present edition, I have added a few remarkable figures from Dr. Golding Bird and others.

LITHIC ACID

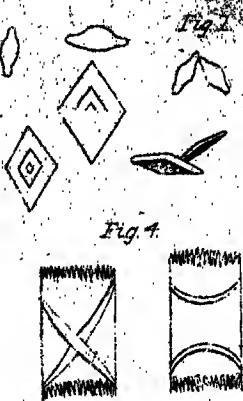


Fig. 2.

Fig. 3.

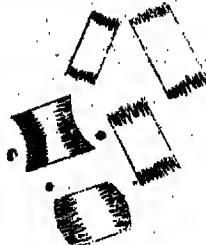
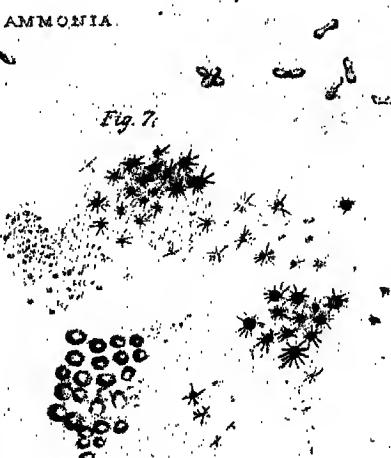


Fig. 5.

LITHATE OF AMMONIA



Fig. 7.



OXALATE OF LIME

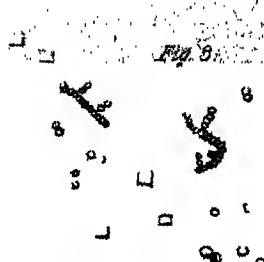


Fig. 9.

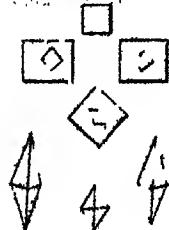


Fig. 10.



Fig. 11.



CYANIC OXIDE.

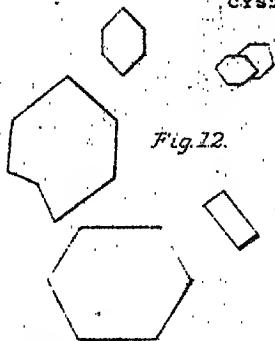
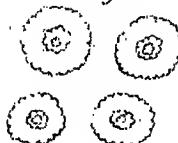


Fig. 12.

Fig. 13.



Fig. 14.



TRIPLE PHOSPHATES.

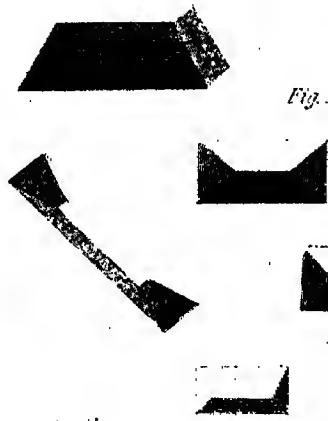


Fig. 15.

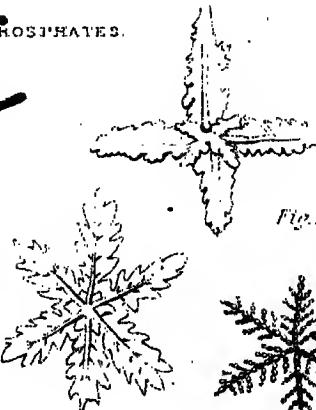


Fig. 16.

UREA.

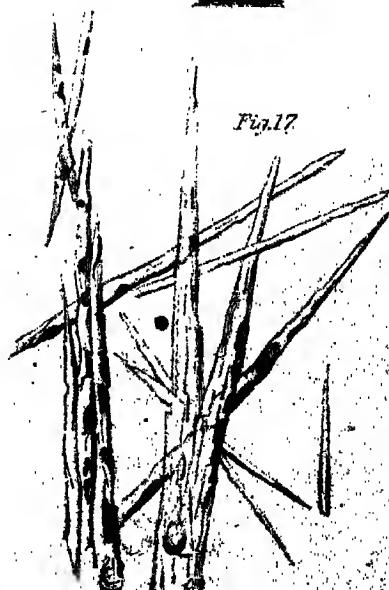
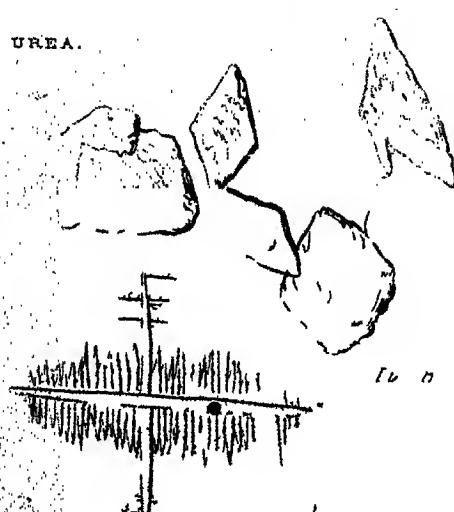


Fig. 17.



10 o

GLOBULES OF BLOOD.

Fig. 19.

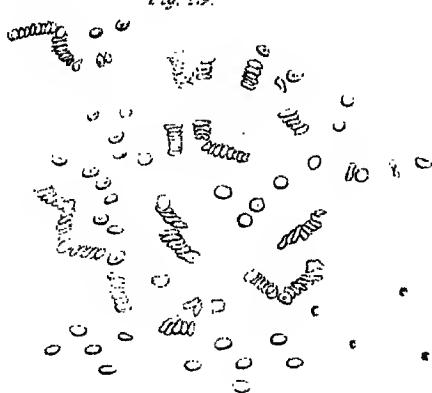
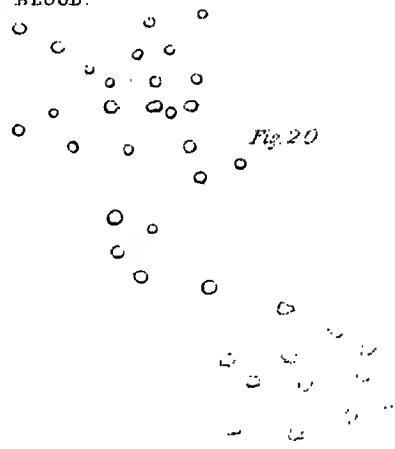


Fig. 20



GLOBULES OF PULM. & OF MUCUS.

Fig. 21.



Fig. 22



EPITHELIUM & MUCUS.

Fig. 23



Fig. 24.



PLATE I.

FIG. 1.—Represents the ordinary appearance of lithic acid crystals, under the microscope. The crystals are rhomboidal prisms; thin, transparent, and of a yellow colour.—M. Rayer.

FIG. 2.—Rhomboidal prisms of lithic acid, thicker than those depicted in the preceding figure; and, in some instances, approaching to the cubic form. The cubic is much more rare than the rhomboidal variety of crystal.—M. Rayer.

FIG. 3.—Modified serrated tables of lithic acid found in very acid urine.—Dr. G. Bird.

FIG. 4.—Serrated crystals of lithic acid, showing the crescentic structure obtained by precipitating urine by acetic acid. The serrations resemble a compact series of dark lines.—Dr. G. Bird.

FIG. 5.—Lithic acid in cylinders.—Dr. G. Bird.

FIG. 6.—The usual appearance presented by the lithate of ammonia; namely, that of an amorphous powder, the particles of which are either collected together into little masses, or scattered over the field of the microscope.—M. Rayer.

FIG. 7.—Are other forms assumed by the lithate of ammonia; namely, dark-coloured globules dispersed through the amorphous powder; around a great number of which, minute radiating crystals, of the superlithate of ammonia, in the form of a star, are disposed.—M. Rayer.

FIG. 8.—Represents the appearance under the microscope, of the oxalate of lime formed by the precipitation of the lime in the urine, by the addition of oxalic acid.

FIG. 9.—Crystals of oxalate of lime resembling two superposed cubes: and acute octohedrons, the form most usually found in deposits.—Dr. G. Bird.

FIG. 10.—Form occasionally assumed by the oxalate of lime, according to Dr. G. B. I have seen such forms, but did not know to what order to refer them. *Dumbbell* crystals.

FIG. 11.—Represents a flat octohedron; the form, stated by Wollaston many years ago, to be that most frequently assumed by crystallised oxalate of lime. According to the observations of Mr. Brooke, however, some natural crystals of the oxalate of lime, containing one proportion of water, presented the form of an oblique rhombic prism. See Lond. and Edin. Philos. Mag. vol. xvi. p. 449, (1840.)

FIG. 11* and 12* represent the appearance of the hippuric acid under the microscope.—Dr. G. Bird.

PLATE II.

FIG. 12.—Crystals of cystic oxide, obtained from its solution in ammonia, by evaporation. They appear as transparent hexahædral prisms, more or less regular, and of various sizes. The crystals of this substance are often so thin as to assume the form of hexahædral plates.
—M. Rayer.

FIG. 13.—Ditto after Dr. G. Bird.

FIG. 14.—Serrated crystals of cystic oxide.—Dr. G. Bird.

FIG. 15.—Crystals of the *neutral* triple phosphate of magnesia and ammonia, such as they are either spontaneously deposited from neutral or alkalescent urine; or by precipitation from that secretion on the addition of ammonia. These crystals are white and transparent, and their form is either derived or modified from a right rectangular prism.

FIG. 16.—Different forms assumed by the *bibasic* triple phosphate of magnesia and ammonia, sometimes deposited by putrid urine; or when ammonia has been added in excess to that fluid.

FIG. 17.—Crystals of urea, obtained from a solution of that substance in aleohol.

FIG. 18.—Scales and crystals of the nitrate of urea, formed when nitric acid is added to concentrated urine.

PLATE III.

FIG. 19.—Globules of blood, as they usually appear when examined between two glasses in a microscope: namely, as flattened discs of a deep yellow colour, with an opaque point in their centre. The red particles of human blood have been found to vary, in different instances, and by different observers, from the $\frac{1}{5000}$ to the $\frac{1}{2537}$ of an inch. Sir E. Home and Mr. Baucer estimated their size to be larger; or at $\frac{1}{1700}$ of an inch. This subject has been recently investigated by Mr. Wharton Jones and others.

FIG. 20.—Blood globules collected from the urine in haematuria. The globules towards the bottom appear slashed and otherwise altered, from remaining for some time in the urine; though they retain their yellow colour.

FIG. 21.—Globules of pus exhibiting a granulated surface, and slashed appearance round the circumference. They are nearly colourless, and frequently adhere to each other. The globules of pus are not flattened like those of the blood, but are perfectly spherical. Their size is said to vary a little from a mean of $\frac{1}{2500}$ of an inch.

FIG. 22.—Globules of cow's milk, such as they appear under the microscope, either naturally, or immediately after they have been mixed with the urine. Some are larger than others, and surrounded by a well-defined edge; others are smaller, and of a paler colour. Milk globules are from $\frac{1}{3}$ to $\frac{1}{2}$ less than the globules of the blood.

FIG. 23.—Lamellated scales of epithelium, and globules of the mucus of the urinary passages. Some of the mucous globules appear to be attached to the scales of the epithelium.

FIG. 24.—Globules of mucus entangled in a lamina of coagulated albumen.

The objects in this plate are all from M. Rayer's work.

PLATE III.¹

FIG. 25.—Epithelial cells from a healthy kidney, containing a few small oil globules in their interior.

FIG. 26.—Epithelial cells from a kidney affected with Bright's disease. The oil globules in these cells are much larger and more numerous than in those from the healthy kidney.

FIG. 27.—Portion of one of the urinary tubes from a kidney affected with Bright's disease. The oil globules contained in the epithelial cells by which the tube is lined, are here seen through the wall of the tube.—*Dr. Johnson Med. Chir. Trans. xxix. p. 1.*

FIG. 28.—Section of a portion of inflamed kidney. The tubes appear as if divided into distinct globular and oval portions ; this appearance results from the manner in which the tubes are packed in the meshes of the fibrous tissue, so as to be concealed where they are crossed by the fibrous tissue, and visible in the intervals. The tubes are rendered opaque by an accumulation of epithelium, the outline of the cells being invisible on account of their crowded condition. A Malpighian body in the centre of the mass appears transparent and healthy.

FIG. 29.—Section of a portion of kidney, showing the tubes deprived of their epithelium by “chronic desquamative nephritis.” The appearance of the tubes is very similar to that of globular and oval transparent cysts. The explanation of this appearance is given above.

FIG. 30.—Includes fibrinous casts of the urinary tubes entangling epithelial cells and blood corpuscles, free epithelial cells, and crystals of lithic acid from the urine, in a case of “desquamative nephritis.”

FIG. 31.—Cast of a urinary tube composed of fibrinous matter and disintegrated epithelium from the urine in a case of “chronic desquamative nephritis.”—*Dr. Johnson Med. Chirurg. Trans. xxx. page 165.*

FIG. 32.—Appearance described at page 192 of this volume. The highest magnifying power I possess (about one-eighth of an inch,) shows no more than is here represented.

FIG. 33.—Spermatic animalcules. *Spermatozoa.*

FIG. 34.—Torulae developed in diabetic urine. Dr. Golding Bird.

Fig. 25.



Fig. 26.

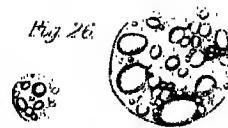


Fig. 27.

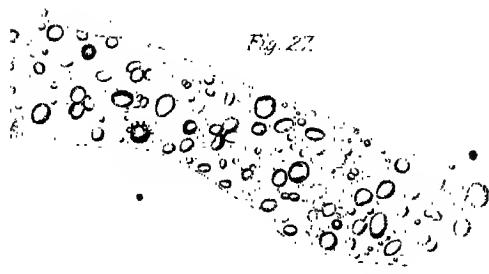


Fig. 28.

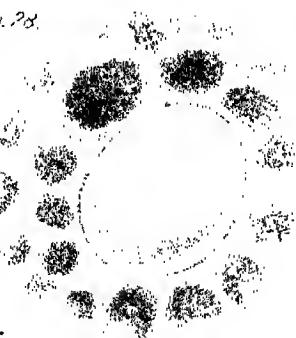


Fig. 29.



Fig. 30.



Fig. 31.



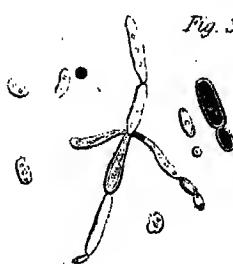
Fig. 32.



Fig. 33.



Fig. 34.



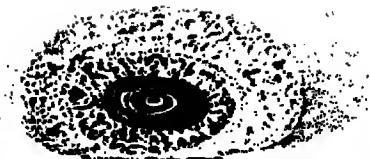
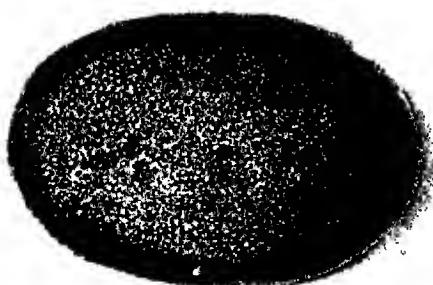


PLATE IV.

URINARY CALCULI.

Lithic acid series.

FIG. 1.—Is an exterior view of the common lithic acid calculus. From a specimen in the Museum of the Royal College of Surgeons.

FIG. 2.—Represents a fragment of a well-defined crystallised lithic acid calculus. In this variety (abstracting the colouring matters) the lithic acid is remarkably pure. It is not a very common variety, but when it does occur, sometimes acquires a very considerable magnitude; as was the case with the specimen of which this was a portion.

FIG. 3.—Is a section of the common compact lithic acid calculus. The centre of this calculus, though not crystallised, approaches Fig. 2 in colour and purity; while its exterior laminæ are much less pure, and of a paler colour; and contain, mixed with the lithic acid, more or less of the lithate of ammonia and the phosphates. From a specimen in the Royal College of Surgeons.

FIG. 4.—Represents the common lithate of ammonia calculus. From a specimen in the Royal College of Surgeons, stated to have been taken from a girl seven years of age.

FIG. 6.—Is a portion of a section of a calculus consisting internally of the lithate of ammonia, and externally of the triple phosphate of magnesia and ammonia nearly pure. This calculus was the *second* taken from a young gentleman about thirteen years of age.

FIG. 6. Is the entire section of a calculus containing, like the last, a lithate of ammonia nucleus, but surrounded by the mixed phosphates, or *fusible* deposite. It was taken, after death, from the bladder of a boy six years old, who had died from the irritation produced by it.

Thus the changes which the lithic acid species of calculus usually undergoes in its progress towards the phosphates, are—*crystallised and nearly pure lithic acid*; *compact and deep-coloured lithic acid*; *lithate of ammonia*; *the triple phosphate of magnesia and ammonia*; and *the mixed phosphates*. See Tables in the Appendix.

PLATE V.

URINARY CALCULI.

Oxalate of lime series.

FIG. 7.—Is an exterior view of an oxalate of lime or mulberry calculus. From a specimen in the Royal College of Surgeons.

FIG. 7*.—Is a specimen of the white crystallised variety of the oxalate of lime calculus noticed at page 575.

FIG. 8.—Represents an internal view of the oxalate of lime calculus.

FIG. 9.—Represents the section of a calculus showing the alternation of the lithic acid and mulberry deposite. In the centre is a nucleus consisting principally of the lithic acid. Externally to this is the mulberry deposite; and to this again succeeds the lithic acid, which constitutes the whole external crust. From a specimen taken from the kidney after death, and for which the author is indebted to Dr. Elliotson.

FIG. 10.—Is from a specimen in the Royal College of Surgeons. In the centre is the lithic acid; then follows the oxalate of lime; while exterior to the whole, are the mixed phosphates.

FIG. 11.—Is an *external* view of a calculus composed of the mixed phosphates, or the fusible calculus. From a specimen in the Royal College of Surgeons.

From this series we see that the lithic acid and the mulberry depositories alternate with each other. The phosphates here, however, as in the lithic acid species, are almost always *external*.

See Tables in the Appendix.

7



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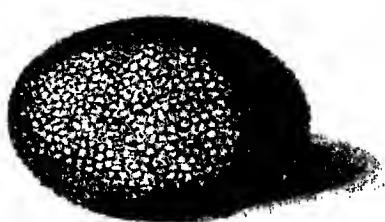
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PLATE VI.

URINARY CALCULI.

Cystic oxide, and phosphate of lime or prostatal calculi.

FIG. 12.—Is an external view of the cystic oxide calculus. From Dr. Marcet's work on Calculous Disorders.

FIG. 13.—Is a section of another specimen of this rare species of deposit, in the author's possession; for which he was indebted to the late Dr. Henry, of Manchester.

The author has seen no specimen of this species of calculus surrounded by the phosphates; though an instance of such occurrence has been noticed by Dr. Wollaston, its discoverer.

FIG. 14.—Are specimens of the small rough variety of prostatal concretion, which usually occurs in that gland before any extensive disorganisation has taken place.

Figs. 15, 16, and 17, represent specimens of the porcelainous variety of concretion occurring in abscesses of the prostate. Fig. 15, is an external view. Fig. 16 represents a section, and showing the radiating striae peculiar to the phosphate of lime concretion. Fig. 17 is an irregular fragment, somewhat resembling a piece of bone or shell. These specimens were removed from the prostate by Sir B. Brodie.

DISEASES OF ASSIMILATION AND OF SECRETION.

PATHOLOGY, or the doctrine of Disease in general, is naturally comprised under three great heads or divisions, viz.—FUNCTIONAL DISEASES, or those derangements arising from abnormal action of one or more organs of which animal bodies consist: ORGANIC DISEASES, or those diseases arising from actual lesions of one or more of the organs themselves: and MECHANICAL DISEASES, or those diseases arising from mechanical causes; such as from the imperviousness or obliteration of organs by disease; or from the presence of calculi, &c., in the kidney or bladder. As, however, we rarely find diseases exclusively belonging to either of these three great divisions; and as the two last divisions, in particular, are almost always associated in those diseases of assimilation and of secretion which form the chief objects of this volume; we shall consider the practical part of our subject under two general heads only, viz.

FUNCTIONAL DISEASES; or those diseases arising from the deranged operations and less obvious lesions of the assimilating and secreting organs; and

MECHANICAL DISEASES ; or those diseases arising from obvious lesions of organs ; and from the presence of calculi, &c., in the bladder.

These two great classes of diseases will form the subjects of the first two Books, or PARTS, into which the *practical* portion of our Treatise is divided.

A third Book or PART will comprise an

OUTLINE of the GENERAL PHYSIOLOGY and PATHOLOGY of assimilation ; and of the SECRETION of the BILE and of the URINE.

In the former editions of our volume, the *third* Book, or PART, was placed at the beginning, and constituted the INTRODUCTION. The reasons for inverting this arrangement have been briefly stated in the Preface to the fourth edition.

B O O K I.

OF FUNCTIONAL DISEASES.

COMPREHENDING THE DESCRIPTION AND TREATMENT OF DISEASES
ARISING FROM THE DERANGED OPERATIONS AND LESS OBVIOUS
LESIONS OF THE ASSIMILATING AND SECRETING ORGANS.

THE proximate alimentary principles by which the existence of animals is maintained, though much modified by the assimilating processes, are essentially the same as those principles of which animal bodies consist. This important fact being now generally admitted, we have here to show—that the processes by which alimentary matters are assimilated in animal bodies are constantly liable to be deranged, both in degree and in kind;—that such derangements of the assimilating processes are manifested by corresponding derangements in the various products secreted from animal bodies by the organs designed for such purposes, and particularly by the kidneys and liver; and, lastly;—that the relations between the deranged products of secretion and the proximate principles by which animal existence is maintained, and of which animal bodies consist, enable us, in many instances, to acquire a more correct knowledge of the organ deranged, as well as of the nature of the derangements, than can be obtained by any other means.

The proximate alimentary and staminal principles of animals consist of four great classes, viz. the Aqueous, the Saccharine,

the Albuminous, and the Oleaginous classes; and in conformity with this constitution, we shall consider the Pathology of the assimilating processes under four similar heads. The first Book or PART of our Treatise, therefore, will comprise the following subjects:

CHAP. I. General observations on the Pathology of Aqueous assimilation and secretion.

- Section a.* Of the relation of Fluids to the assimilating processes in Health and in Disease.
- b.* Of the relation of Fluids to Nephritic operations in Health and in Disease.

CHAP. II. General observations on the Pathology of Saccharine assimilation and secretion.

- Section a.* Of Saccharine urine. *Diabetes.*
- b.* Of Oxalic acid; Oxalate of Lime.
- c.* Of Lactic acid, &c.

CHAP. III. General observations on the Pathology of Albuminous assimilation and secretion.

- Section a.* Of an Excess and Deficiency of Urea.
- b.* Of Albuminous urine.
- c.* Of Lithic acid.
- d.* Of Cystic Oxide, &c.

CHAP. IV. General observations on the Pathology of Oleaginous assimilation and secretion.

- Section a.* Of an Excess and Deficiency of fat.
- b.* Of Cholesterine and its deposits, &c.

The important class of diseases, arising from the Mineral matters incidental to the proximate animal principles, will be separately considered under the head of

CHAP. V. General observations on the Pathology of the Incidental Mineral matters entering into the composition of organized bodies.

Since, from the nature of the preceding arrangement of our subjects, the *abnormal condition of the secreted products* is supposed to constitute the prominent feature of the derangement, or in other words, the DISEASE; in speaking of the individual

derangement or diseases, we shall first describe the abnormal state of the secretion constituting the Disease; and afterwards point out the general constitutional symptoms or derangements by which the abnormal state of the secretion is usually accompanied. These points being considered, the Diagnosis, Prognosis, and Treatment of the peculiar derangement, will follow in the usual manner.

CHAPTER I.

GENERAL OBSERVATIONS ON THE PATHOLOGY OF AQUEOUS
ASSIMILATION AND SECRETION.

As *water* enters into the composition of organized beings more largely than any other principle, its influence in organic operations is very remarkable. Indeed, the consideration of water in all its relations to vital phenomena would involve little less than the complete history of such vital phenomena, normal and abnormal. Into an inquiry so extensive it is not our purpose to enter; our attention at present is chiefly directed to that portion of water more immediately concerned in the processes of assimilation, and which subsequently passes off through the kidneys in the form of *urine*.

The signal that water is required for the purpose of the animal economy is denominated *thirst*; and if this signal be obeyed, and water be taken in the requisite quantity, the thirst ceases; and all the purposes served by water are accurately fulfilled. The water thus taken into the system is employed in two modes; as a simple diluent constituting the medium or vehicle in which most organic operations are carried on; and as immediately associated with organized principles, or furnishing certain of the elementary materials of which they consist. These two modes in which water is employed in the animal economy are not only essentially distinct in their character, but apparently remain distinct throughout the whole range of aqueous operation.

In a perfectly natural condition of the system, when water is taken in large quantity, even during the processes of digestion, it interferes less with the functions of the stomach than might be expected; for, by a beautiful provision, the superfluous water

is immediately absorbed into the sanguiferous system, or passes downward into the bowels. Of the portion taken into the blood, so much is appropriated as is required to maintain its due fluidity ; while the excess, if any, is expelled from the system ; during the summer, chiefly by the skin and lungs ; and during the winter, by the kidneys. This escape of water from the system, as in all vital operations, is rendered subservient to another important purpose. Together with the water, and in solution in it, various effete and noxious matters are removed, the retention of which would prove fatal to the economy. Such matters pass off with the water from the skin and lungs in abundance, though their nature is imperfectly understood : the matters which pass off with the water through the kidneys and constitute the heterogeneous ingredients of the urine, form a principal object of inquiry in the present volume.

The portion of water inseparably associated with the alimentary matters, or which enters as hydrogen and oxygen into their composition, may in part be derived from the fluids taken into the stomach. There is reason, however, to believe that the water thus associated or decomposed, is chiefly derived from the blood ; and that the association and decomposition are effected during the secretion of the fluids immediately subservient to the assimilating processes.

The more prominent natural relations of water to organic operations are here recited, for the sake of deducing from them certain important practical inferences regarding the employment of fluids, both in the healthy and deranged condition of the assimilating and urinary organs. These inferences we shall class under the two following SECTIONS, viz.—SECTION a. *The relation of Fluids to the assimilating processes in Health and in Disease* ; and SECTION b. *The relation of Fluids to Nephritic operations in Health and in Disease*.

SECTION a. *Of the relation of Fluids to the assimilating processes in Health and in Disease.*

It has been stated, that in a perfectly healthy condition of the stomach, superfluous water is speedily removed from that organ without materially affecting its functions. In a variety of dyspeptic derangements, however, this important function is liable to be impaired or suspended ; and the fluids taken remain in the stomach, and embarrass in no small degree the digestive operations. Under such circumstances the solid food is either imperfectly digested, or is converted into unnatural ingredients ; and the patient, in consequence, is annoyed with flatulent distension, and a variety of distressing symptoms, which frequently do not cease till the whole are rejected. If not rejected, the half-digested food, after a long time, escapes into the bowels, and deranges their functions ; while the fluid portion, loaded to excess with unnatural matters, is absorbed into the system, to be thrown off by the various outlets above mentioned, and particularly by the kidneys ; to the great detriment of their functions.

A leading practical inference from these remarks is, that individuals who are subject to stomach derangements should carefully abstain from the admixture of fluids, as soups, &c., with solid food ; and, consequently postpone the use of diluents till the digestive processes are completed. Indeed, so strongly has the force of this remark been felt, that it has long become an established custom among the indolent and overfed dyspeptics of civilized society, to resort to the use of diluents, in the shape of tea, &c., two or three hours after the principal meal. It may be worth while also to notice here, that the use of diluents, at this period, offers the most favourable opportunity for the employment of small doses of alkali, with the view of preventing the secondary effects of the acid remains of the meal on the system ; as will be more particularly shown hereafter.

With regard to the use of *stimulating* fluids during meals, it may, perhaps, be laid down as a rule, without exception, that the stomach requiring their aid to enable it to do its duty, is in a state of disease; or certainly not in its *natural* state. Most of the vinous liquors employed for such purposes, besides their essential

principle *alcohol*, contain various acid and saccharine matters in ill-defined and transition states. This is particularly the case with most malt liquors, and with wines of the effervescent class, as champagne, &c.; than which, nothing can be worse adapted as diluents when the assimilating powers are weak; for the moment such fluids enter a debilitated stomach, they act as ferment, and are not only converted into acids themselves, but dispose everything else to undergo similar changes. All vinous liquors, therefore, possessing such characters should be carefully shunned by sedentary and dyspeptic individuals; and a little sound sherry, which contains less acid and sugar than any other wine; or a little pure brandy, which contains neither, should be preferred. Moreover, when their *stimulating* qualities is the object sought, it will be better to take these liquors, at least wine, *undiluted*; as weak wine, and even weak spirit, readily pass into an acid condition, and thus their only valuable effects are lost.

Another practical inference relates to the use of fluid remedies, and especially to the use of mineral waters. Pure water, as already stated, if taken into an empty stomach, readily escapes from the system by all the various outlets, and even by the bowels; provided it be in sufficient quantity, and assisted by moderate exercise. Mineral waters in general, therefore, whether they contain active ingredients or not, are best administered in the morning; not only for the reason stated, but because when so taken, they do not interfere with the digestive processes. This practical fact is well understood, especially on the continent; where mineral waters are usually resorted to early in the morning, and such an interval allowed before breakfast, as to permit their escape from the stomach at least; and in many instances, from the system; either by the bowels, kidneys, or skin, according to the properties of the waters. When not convenient or proper in the morning, mineral waters may be advantageously administered in the intervals between meals; and many of the alkaline waters in particular, are taken with the greatest effect in the evening, some hours after the principal meal; but at such an interval as to allow the greater portion to escape by the kidneys before retiring to rest. To enter into details here, however, respecting the administration of mineral waters in general, would be foreign to our purpose.

The effects produced by a *deficiency* of fluid in the stomach

during the assimilating processes, are less understood than those produced by an excess ; for, as already noticed, when fluids are really required by the system, the signal of thirst becomes so urgent, as not only to arrest our attention, but to oblige us to resort to the use of fluids if within our reach. When, under these circumstances, fluids *cannot* be obtained, no substitute will supply their place ; and the assimilating processes, in common with all the other vital operations, must soon entirely cease.

With regard to the *appropriation* of water during the processes of assimilation, this, like the processes of assimilation themselves, is little understood. There can be no doubt, however, that the appropriation of water, like all similar operations, is a *vital* act ; that is, the appropriation of water either depends on the influence and agency of the organs of assimilation immediately exerted ; or on the influence of some (generally fluid) principle secreted by these organs from the blood, and operating as the medium by which the vital act of appropriation is accomplished. Moreover, the processes by which water is appropriated, like other vital processes, take place slowly, and never *per saltum*. As instances of such deliberate change, we may mention that the alimentary matters, during their *reduction* into chyle, are gradually and slowly combined with water ; and that, on the other hand, the chyle, during its conversion into blood, is gradually *raised* or separated from its associated water. The due performance, therefore, of these and other functions in which water plays a conspicuous part, must depend on a regulated supply ; and the presence of either too much or too little water will necessarily render assimilation difficult, and more or less incomplete.

Similar remarks may be made with regard to the appropriation of the component elements of water, hydrogen, and oxygen.

SECTION b. *Of the relation of Fluids to Nephritic operations in Health and in Disease.*

In the consideration of the fluids passing off through the kidneys, the first points to be attended to are—the *normal quantity* of urine voided by a person in health in a given time; and the average *specific gravity* of such normal quantity. We have stated, in the third Part of this Treatise, that both these data are subject to great diversities from climate, and from a variety of other causes; so that it is impossible to name any one quantity or weight that shall be universally applicable. In this country we have supposed the average quantity and specific gravity of the urine voided in twenty-four hours by an adult individual in health, who does not drink more than the simple wants of nature require, to vary from thirty ounces of specific gravity 1.025 in the summer, to forty ounces of specific gravity 1.015 in the winter; and these averages are probably near enough the truth for all practical purposes.

The secretion from the kidneys has been long divided by physiologists into the *urina sanguinis*—the urine voided from the blood only; and the *urina potūs*—the urine voided after drinking and moderate eating. Perhaps a more correct division and nomenclature would be—the *urine of the blood*, or the urine resulting from the *secondary assimilating processes* only; and the *urine of assimilation*, including the urine resulting from both the primary and secondary assimilating processes.

In a perfectly healthy individual, who duly follows the dictates of nature, there ought to be little or no difference between the specific gravity and quantity of the urine voided at different times during the same given interval of twenty-four hours; i. e. every specimen of urine voided should have nearly the same specific gravity, and the whole, taken together, should coincide with the standard specific gravity and quantity above mentioned. So far, however, is this from being the case, that there are few persons in whom the urine of assimilation does not deviate more or less from the healthy standard, both in specific gravity and quantity; and the degree and nature of the differences often throw much light on

the derangements of the assimilating organs. The urine of the blood in general is more uniform in its properties; but when it does vary remarkably from the standard of health, the deviation generally denotes some deep-seated and constitutional disease of an unfavourable character.

Although, from their incessant activity, we cannot entirely separate the secondary assimilating processes and their derangements, from the primary assimilating processes and their derangements; yet by examining the urine *before* and *after* eating; for instance, in the *morning before breakfast*, and in the *evening after dinner*; we are enabled to form a tolerable estimate in most cases, both of the primary and secondary derangements.

The *morning urine*, in a state of health, like the *urina sanguinis*, of which it may be considered as the representative, is, in general, uniform in its properties. In different diseases, however, of a deep-seated character, both constitutional and nephritic, the morning urine is liable to great derangements, both in quantity and quality. Of these derangements, and of their indication, the following are the most remarkable.

If the morning urine be copious, transparent, and pale-coloured, the presence of formidable derangement of some kind may be usually suspected. If, in addition, the urine be acid, of *low* specific gravity, and *serous*, disease of the kidneys almost certainly exists. On the contrary, if the morning urine be copious, transparent, pale-coloured, and of *high* specific gravity, the existence of diabetes is denoted. Scanty, *transparent*, deep-coloured, and acid urine usually accompanies continued fever. Scanty, *turbid*, red, and very acid urine, *intermittent fevers*, gout, rheumatism, &c. When the sediment of turbid morning urine is pale-coloured, or of a bright pink colour, some deep-seated affection of the chylopoietic viscera retarding and rendering incomplete the assimilating processes, is commonly indicated. These remarks apply to the morning urine as influenced by normal quantities of fluid. When the quantity of fluid taken has been abnormal, of course the quantity of the urine must be abnormal likewise. Thus, if large quantities of *pure* water be taken early in the morning, the secretion, simply diluted, and without any relative change among its other ingredients, constitutes the *urina potis* of authors. But if the water taken contains foreign bodies in-

solution, as various saline matters, these will be transmitted by the water through the kidneys in greater or less proportion, and be found in the urine; as happens during the employment of many mineral waters, &c.

The urine voided in the *evening after dinner*, or the *urine of assimilation*, is subject to much greater variations, both in quantity and quality, than the urine voided in the morning. Even in those who consider themselves to be in good health, the evening urine is often deep-coloured, above the average specific gravity, and during the winter months is apt to become turbid on cooling. Such deviations, however, from the normal state are the most remarkable, in the urine of dyspeptics; particularly in a cold and chilly state of the atmosphere, and when the skin is inactive from want of exercise, or from other causes. Under such circumstances we can often distinctly detect, by the smell of the urine, the nature of the preceding meal; more especially if matters containing a volatile empyreumatic oil, or possessing other strong sensible qualities, have been taken.

When the urine of assimilation is above, or of the average specific gravity, deep-coloured, and *serous*, incipient disease of the kidney, of a congestive or inflammatory character, may be suspected. The same tendency is also usually indicated when the evening urine is acid and heavy, and when, on becoming turbid, the lithate of ammonia remains partially suspended; such urine being frequently serous. *Heavy*, copious, transparent, and pale-coloured *acid* evening urine generally indicates diabetes. On the other hand, very *light*, copious, transparent, and pale-coloured *acid* evening urine usually denotes serious disorder, and often *disease* of the kidney. When the evening urine presents the same phenomena, but is *neutral* instead of being acid, a relative excess of the triple phosphate, or of urea, may be apprehended.

We give these instances by way of illustration. To enter minutely into the details of urinary derangements, would be, in fact, to anticipate the contents of the present volume? What has been stated is sufficient to show the kind of information to be obtained from the urine, and from the *urine alone*—information of so much importance, that the very existence of the patient may depend on its being duly known and appreciated.

CHAPTER II.

GENERAL OBSERVATIONS ON THE PATHOLOGY OF SACCHARINE
ASSIMILATION AND SECRETION.

SINCE the second edition of this work was published in the year 1825, the class of diseases connected with the imperfect and mal-assimilation of the Saccharine principle has occupied much of my attention ; and soon after the period mentioned, my observations and researches gradually led me to form particular views on the subject, of which an outline was given in the Gulston Lectures, delivered before the College of Physicians.* Subsequently to the publication of this sketch, I have had abundant opportunities of verifying and extending my views ; and though still far from perfect, they furnish an outline, which, I trust, future observations will complete.

The blood of a perfectly healthy individual scarcely contains an appreciable quantity of sugar ; though that article may have formed a portion of his food. The Saccharine principle, therefore, must be convertible, by the agency of the primary assimilating functions alone, into the constituent principles of the blood.† Now, from the relative composition of the Saccharine principle, and of the constituent principles of the blood, it necessarily follows, that *the faculty of thus converting the Saccharine principle, must constitute a distinct function* ; and, as a large proportion of the food of all animals consists of modifications of the Saccharine principle, this function must be of the most important kind. But if the existence of such a function be admitted, it must be admitted also, that, like any other function, the assimilation

* See Medical Gazette, vol. viii. 1831.

† For the arguments in favour of this opinion the reader is referred to the third Book.

of the Saccharine principle may become deranged or suspended ; that is, the primary assimilating organs may become unable to assimilate the Saccharine principle. I need not say that this point is now no longer a matter of uncertainty, as in the disease to be presently considered, namely Diabetes, sugar has been repeatedly ascertained to exist in the sanguiferous system ; a fact unequivocally demonstrating that the assimilating organs had failed to convert the Saccharine aliment into the constituent principles of the blood.* As a further illustration of this point we may state, that the first step of the assimilation of alimentary matters is accomplished by the *reducing* function of the stomach. Now the reduction of all the forms of the Saccharine principle appears to be accompanied by the development of a *low* sugar ; which low sugar, in the healthy condition of the organs, is speedily converted into oleaginous, albuminous, and perhaps other matters. Hence, as the existence of sugar in the stomach is only momentary, its presence in the healthy condition of the organ is with difficulty detected. In Diabetes, however, the *reducing* function of the stomach is for the most part morbidly active, while the *converting* function is more or less suspended or paralysed. In the diabetic stomach, therefore, sugar is found in large quantity, particularly when farinaceous aliments have been taken ; and from the stomach, the sugar readily passes into the sanguiferous system, as just stated. The first step in the derangements, therefore, producing the disease called Diabetes, does not consist, as some have supposed, *in the development of sugar in the stomach, which is a natural process ; but in the greater or less destruction of the converting, and consequently of the still more important organizing functions of the assimilating organs.*

In the diseases above mentioned, the function by which the saccharine principle is converted into the constituents of chyle, is suspended or destroyed. In other diseases, however, this im-

* In confirmation of this point, it is necessary only to refer to the valuable paper published by Mr. M'Gregor of Glasgow, in the Medical Gazette for May 1837. The point in question, however, had been distinctly determined before the publication of Mr. M'Gregor's paper ; as well as repeatedly since that period. Sugar has been recently detected in various other secretions besides the urine, in Diabetes.

portant function is not destroyed, but *erroneously exerted*, and the consequence is, that many principles, some of them of a poisonous character, as, for instance, the oxalic acid, are developed from the saccharine principle during the assimilating processes. That oxalic acid *must* be occasionally developed in the system is evident from the fact, that this acid is found in the urine when it has not been taken into the stomach. Now, when we consider that oxalic acid, taken into the stomach, passes through the kidneys unchanged;* and that those who take sugar in excess are often liable to oxalate of lime concretions; there can be little doubt that the oxalic acid found in the urine is occasionally developed in the primary assimilating organs, and most probably in the stomach itself.+

In the healthy state of the system, sugar never appears to be developed during the secondary assimilating processes. There is reason, however, to believe, that in the advanced stages of Diabetes, sugar is not only developed during the conversion of the albuminous principles of the blood into the gelatinous tissues; but also during the secondary assimilation of the gelatinous, and even perhaps of the albuminous and oleaginous tissues. Moreover, we cannot doubt that the converting functions of the secondary assimilating processes, like the converting function of the primary assimilating processes above mentioned, is liable to be *erroneously exerted*; and that various unnatural products are, in consequence, developed in the system. For obvious reasons, however, we know less of the unnatural products resulting from the derangements of the secondary, than of the primary processes of assimilation; though it is probable, from the following facts, that the *oxalic* and *lactic* acids are occasionally included among the unnatural matters resulting from the derangements of the secondary, as well as of the primary assimilating functions.

* Majendie and others have shown, that where large quantities of the *Rumex*, *Oxalis acetocella*, &c., have been employed as food, the oxalic acid passes through the kidneys, and frequently gives occasion to the mulberry calculus.—*Recherches physiologiques et medicales sur les causes, &c., de la Gravelle*, pp. 39, 126. In some instances the analogous acid termed the *oxauric* acid is supposed to be generated.

+ See the third Book, and, SECTION b. of the present chapter, for additional observations and arguments on this subject.

It will be shown hereafter, that *oxalic* acid in small quantity occasionally passes through the system, without producing any remarkable external symptoms of its presence ; it will be also shown, that in many other instances the presence of oxalic acid in the system is accompanied by certain cutaneous and other diseases more immediately connected with the gelatinous tissues. Now, although we cannot *prove* that the oxalic acid in the latter case is the result of the same derangements of the secondary assimilating processes which give immediate occasion to the cutaneous affection ; yet when, in addition to the preceding facts, we further take into account the relation of the gelatinous to the saccharine principle ; no supposition appears more probable, than that *one* of the derangements of the secondary assimilation of the gelatinous principle may consist in the development of oxalic acid.

But if this reasoning be deemed inconclusive with respect to the development of the oxalic acid during certain derangements of the secondary assimilating processes ; its validity, perhaps, will scarcely be questioned with respect to the development of the *lactic* acid during certain other derangements of the secondary assimilating processes ; for on what other supposition can we explain the presence of those enormous quantities of the lactic acid which occasionally exist in the system during rheumatic and hectic fevers ? Will any one contend that all this lactic acid is, in such instances, developed in the stomach ?

The constitutional symptoms connected with the development of sugar, and of the oxalic and lactic acids, will be considered in future sections of this chapter ; and we proceed to notice briefly a point to which we have before alluded, viz. that besides the oxalic and lactic acids, *other unnatural principles* (of an acid and poisonous character ?) appear to be occasionally developed from the saccharine principle, during derangements both of the primary and secondary assimilating functions. The exact nature of most of these unnatural principles is at present little known ; but there cannot be a doubt, that many local affections, originating in the gelatinous tissues from mal-assimilation, are accompanied by the development of such unnatural principles. So also, in those malignant fevers of tropical climates, (and even perhaps of our own climate,) which more especially arise from miasmata and con-

tagion, there appear to be many unknown but pernicious principles developed from the saccharine radical. Thus I have been informed that the fluid thrown off from the stomach in yellow fever, and denominated the *black vomit*, is often powerfully acid. The nature of this acid has not been satisfactorily ascertained ; but it probably is the lactic acid ; or it may be an acid of a much more injurious character. I have had no opportunity of verifying these remarks ; and notice the subject chiefly for the sake of exciting the attention of others ; and more especially the attention of practitioners in hot climates, where all such unnatural matters appear to be developed in the most decided forms.*

These observations are sufficient to illustrate the phenomena connected with the mal-assimilation of the saccharine radical ; and it only remains to observe, that organic diseases in general, but particularly those of a deep-seated and malignant character, appear to be more frequently connected with derangement of the gelatinous, (*i. e.* of the saccharine,) than of either the albuminous or oleaginous radicals. We cannot explain this circumstance ; but perhaps it may be referred no less to the peculiar vital character of the gelatinous tissues, than to their fundamental importance ; in other words, the peculiar vital character of the gelatinous tissues, is of that low kind, which renders them liable to be easily influenced by external causes ; while, at the same time, their fundamental importance is such, that to derange or subvert these tissues is, in fact, to derange or subvert the very groundwork of organised beings.

In further illustration of the preceding views, we shall make a few observations on the *causes*, internal and external, producing mal-assimilation of the saccharine principle in general.

The *internal* causes *predisposing* to the mal-assimilation of the saccharine principle, like the causes predisposing to all other diseases, are most generally innate or inherited ; and those who are

* See London Med. and Phys. Journal, vol. lix. p. 100. Also the Boston Med. and Surg. Journal, vol. i. p. 134. The paper alluded to is by Mr. Lyons, who shows the remarkably acid condition of the black vomit in tropical fevers. Mr. L. supposes the acid to be the muriatic acid, and it may be so in part ; but most probably the greater portion of the acid is the lactic acid.

born with such predisposition, are liable to get attacks from slight exciting causes, such as would not in the least degree affect a perfectly sound habit. In some instances, a predisposition to particular diseases is acquired by having had attacks of such diseases before. But all circumstances seriously affecting the general health, and depressing the vital powers, are apt to predispose to the mal-assimilation, both primary and secondary, of the saccharine, as well as of the other proximate principles of which organised beings consist.

Among the *external exciting* causes of saccharine derangements, one of the most simple and frequent is exposure to *cold*; or exposure to the combined influence of cold, and of *moisture*. Thus, in many instances, I have been distinctly able to trace diabetes to exposure to cold; or sometimes to rheumatic attacks brought on by exposure to cold and moisture. In such instances, predisposition to the disease most likely existed in a marked degree; for of the thousands constantly exposed to cold and moisture, comparatively very few get diabetes. Another, and perhaps the most fertile exciting cause of mal-assimilation in general, and particularly of saccharine mal-assimilation, is *malaria*. I do not mean to assert that diabetes is a malarious disease, though I have seen many cases of diabetes from malarious districts. On the contrary, in such instances, I suppose the predisposition existed; and that the malaria, like the cold and moisture, or perhaps in conjunction with cold and moisture, was only incidentally the exciting cause. But although diabetes can be hardly pronounced a malarious disease, a very large proportion of the diseases arising from the mal-assimilation of the saccharine principle may be justly so pronounced. Indeed, I have no hesitation in expressing my belief that almost every form of disease connected with the development, by the secondary assimilating processes, of oxalic acid and the other indefinable (acid?) principles, down to lactie acid; are more frequently excited by malarious influence, than by any other external cause. My attention was forcibly directed, many years ago, to this fact, by seeing, in quick succession, several well-marked cases of oxalic acid disease from a district notoriously malarious. Having been thus accidentally led to observe the circumstance, a number of corroborative instances soon occurred to me; when, shortly after I had begun to consider the point

as established, the Asiatic cholera made its appearance in this country. The effects produced by this remarkable disease on the animal economy; and the temporary revolution in particular, which it occasioned in urinary diseases, may not be uninteresting to the reader.

Every one is acquainted with the familiar fact, that the most frequent and striking morbid appearances presented by the urine from slight causes, (such as a cold, indigestion, &c.,) are the common latcritious sediments. Now, the first circumstance that attracted my notice after the prevalence of the Asiatic cholera, was the disappearance of these sediments from the urine. The absence of these sediments was at first considered to be accidental; but when, day after day, the same occurrence took place, I was induced to inquire attentively into the circumstance, with the view, if possible, of ascertaining the reason. On closer inspection, it was found that the urine of every individual examined, whether in apparent health or otherwise, not only presented the same absence of sediment; but also assumed that peculiar appearance, which I had been accustomed to consider as characteristic of the presence of oxalic acid. As I had always previously found the oxalic acid diathesis of unusual occurrence in London, I was much struck with the phenomenon; and on reflection it occurred to me, that it might be referable to the same unknown cause which was then producing cholera. I was led to this notion from the analogous effects above mentioned produced in the urine by malaria; and also by another curious fact, noticed below,* which likewise

* For some years before the Asiatic cholera appeared in this country, I had been occupied with investigations regarding the atmosphere; and for more than six weeks previously to the actual breaking out of this disease, had almost every day been endeavouring to determine, with the utmost possible accuracy, the weight of a given quantity of air, under precisely the same circumstances of temperature and of pressure. On a particular day, the 9th of February, 1832, the positive weight of the air suddenly appeared to rise above the usual standard. As the rise, at the time, was supposed to be the result of some accidental error, or of some derangement in the apparatus employed, in order to discover its cause, the succeeding observations were made with the most rigid scrutiny. But no error or derangement whatever could be detected. On the days immediately following, the weight of the air still continued above the standard, though not quite so high as on the 9th of February, when the change was first noticed. The air retained its aug-

ook place about the time the Asiatic cholera first made its appearance, viz. a positive increase in the weight of atmospheric air, similar to what might be supposed to be produced by the diffusion of a heavy gaseous principle through the lower regions of the atmosphere. My conclusion therefore was, that the cause of the phenomenon in question, as well as of the cholera, was a poisonous body analogous to malaria, whose high specific gravity and feeble diffusive powers kept it near the earth's surface, along which it insensibly crept, particularly in low and damp situations. Whether this conclusion was legitimate or not, others must decide. I do not think the point worth contesting: but shall briefly mention the following additional facts, connected with the subject.

During the prevalence of the above condition of the urine, I likewise noticed, in almost every individual, an unusually acid state of the saliva, and of the cutaneous exhalations; such as I had never, indeed, before noticed, except in the last stages of chronic diseases; or in malarious affections. Besides these circumstances, I also saw, about the time the cholera prevailed, and a little afterwards, more cases of oxalate of lime renal calculi, and of formidable haemorrhage from the kidneys, &c., than I had ever previously seen during the whole of the long period that urinary diseases had occupied my attention. As the cholera disappeared, the above state of things gradually subsided; but I sometimes imagined that the urine did not for a long time completely recover its former condition. Indeed, during the winter and spring of 1837 and 1838, lithic acid deposits were comparatively rare in London; and the urine assumed much the same appearance as

invented weight during the whole time the experiments were carried on, namely, about six weeks longer. The increase of the weight of the air was small, but still decided and real. The method of conducting the experiments was such as not to allow of an error, at least to an amount so great as the additional weight, without the cause of the error having become apparent. About the 9th of February, the wind in London, which had previously been west, veered round to the east, and remained pretty steadily in that quarter till the end of the month. Now, precisely on the change of the wind the first cases of epidemic cholera were reported in London, and from that time the disease continued to spread.—See my Bridgewater Treatise, page 311, third edition..

during the prevalence of cholera, though in a less marked degree.*

Among the remote causes of saccharine derangements more especially operating from within, may be mentioned the *diet* of individuals or of districts. That a free consumption of sugar will in many persons (probably in certain seasons and in certain malarious districts more than in others) produce a tendency to saccharine diseases, I have not the least doubt; as I have repeatedly seen the oxalic acid diathesis kept in check, and indeed entirely removed, by simple abstinence from sugar. The same remark is applicable to certain articles used as food, and containing the oxalic acid already formed; such as the sorrel and rhubarb tribes of plants. Thus in certain districts of France, where sorrel is much used, oxalate of lime calculi are said to be very frequent.† In this country, the only article in common use that I am acquainted with, containing the oxalic acid in large quantities, is rhubarb; the stalks of which, from their agreeable acidity, are much employed during the spring months. I have seen repeated attacks of oxalate of lime nephritic calculus follow the free employment of this article; and some of them so unequivocally traceable to its use, that no doubt regarding the subject has been left on my mind. Hence I have been long accustomed to prohibit rhubarb tarts, &c., to dyspeptic individuals; and though a strong stomach may assimilate oxalic acid and many other matters equally poisonous, it would be well, perhaps, in all instances that this organ were spared such a trial of its strength.

To the head of deficient, and particularly of *unwholesome* diet, may be referred the occurrence of those frightful epidemics usually attendant on periods of scarcity; and on wet and unfavourable harvests. In such periods, and seasons, the Saccharine principle of the grain itself is either deficient in quantity, or imperfectly developed. The consequence is, that like the oxalic acid above mentioned, the poison is taken ready formed with the food itself, and thus directly exerts its baneful influence on the system. The

* Had the condition of the urine at this time any connexion with the peculiar fever then so prevalent? Within the last four or five years, urinary derangements have resumed in a great measure the characters they possessed before the Asiatic cholera appeared.

† See note, page 16.

same remarks apply, perhaps in a still stronger degree, to food consisting of damaged and putrescent animal matters. All writers on these epidemic diseases agree in representing the blood of the sufferers as unusually dark-coloured; and moreover have generally ascribed these appearances of the blood to the presence of some undefined principle of a poisonous nature. If this explanation be admitted, it is obvious, as above stated, that such poisonous principle can be only derived from the imperfect condition or mal-assimilation of the alimentary matters; and particularly of the Saccharine principle.

Lastly, from the constant existence, in a greater or less degree, of the exciting causes mentioned, among the badly fed and destitute inhabitants of large towns, oxalic acid diseases are at all times of not unfrequent occurrence, particular in public hospitals. Close attention to the subject however for many years, as just observed, has satisfied me that the tendency to this form of Dyspepsia is much more extensively present at some periods than at others.

There is an article much used in various ways, though not as an aliment, the deleterious effects of which on the assimilating organs, &c., require to be briefly noticed, viz. *Tobacco*. Although confessedly one of the most virulent poisons in nature; yet such is the fascinating influence of this noxious weed, that mankind resort to it in every mode they can devise, to ensure its stupifying and pernicious agency. Tobacco disorders the assimilating functions in general, but particularly, as I believe, the assimilation of the Saccharine principle. I have never, indeed, been able to trace the development of oxalic acid to the use of tobacco; but that some analogous and equally poisonous principle (probably of an acid nature) is generated in certain individuals by its abuse, is evident from their cachectic looks; and from the dark, and often greenish yellow tint, of their blood. The severe and peculiar dyspeptic symptoms sometimes produced by inveterate snuff-taking are well known; and I have more than once seen such cases terminate fatally in malignant disease of the stomach and liver. Great smokers also, especially those who employ short pipes and cigars, are said to be liable to cancerous affections of the lips.*

* This has been referred to the continued action of the heat of the pipe or cigar upon the lips: but there is reason to believe that this cause alone is not sufficient to explain the circumstance alluded to in the text.

But it happens with tobacco, as with deleterious articles of diet ; the strong and healthy suffer comparatively little, while the weak and predisposed to disease fall victims to its poisonous operation. Surely, if the dictates of reason were allowed to prevail, an article so injurious to the health, and so offensive in all its forms and modes of employment, would speedily be banished from common use.

These observations might be much extended, did the practical nature of our treatise admit. What has been given, is intended merely as a sketch or outline to draw the attention of observers to the subject ; and which they must fill up and complete. We pass on now to the consideration of some of the more remarkable diseases connected with the Saccharine principle.

SECTION a. *Of Diabetes.*

The term *Diabetes*, implying simply an increased flow of urine, is applicable to any disease in which that symptom is present in a remarkable degree. This general use of the term, however, has caused a great deal of confusion ; as a variety of diseases, differing altogether in their nature, except in the accidental circumstance of being accompanied by *diuresis*, or a large flow of urine, have in consequence been confounded one with another. To prevent this confusion in future, I would recommend that the term be restricted to those affections in which the urine is *saccharine*. Hence I define Diabetes to be a disease in which a *saccharine state of the urine* is the characteristic symptom.

Diabetic urine is almost always transparent, and of a pale straw or greenish colour. Its smell is commonly faint and peculiar ; somewhat resembling sweet hay or milk ; and its taste is usually saccharine in a greater or less degree. The specific gravity of diabetic urine has been stated to vary from 1·020 to 1·050 ; but I have once or twice seen the specific gravity of saccharine urine as

low as 1·015;* and many times as high as 1·055, or even higher. The quantity of urea is sometimes much diminished ; though I have never met with a specimen in which this principle was entirely absent ; and, in some instances, urea is said to exist in diabetic urine in greater proportion than natural. Lithic acid also is usually found in saccharine urine in greater or less quantity ; and in favourable cases of the disease, the quantity of this acid is often very considerable. The usual saline matters existing in the urine are met with in diabetic urine in nearly the same *relative* proportions as in health ; but the *absolute* quantity of saline matters, viewed in relation to the quantity of urine passed, is much diminished. Sometimes diabetic urine contains a little blood ;† and not unfrequently albuminous matter, analogous to that of chyle. I have seen it also contain a white milky-like fluid, precisely similar to chyle, which slowly subsided to the bottom of the vessel. In this case the vinous fermentative process was induced very rapidly in the urine ; the chylous matter apparently acting like yeast.

When, in diabetic individuals, the disorganising function of the kidneys is suspended : or when these glands are partially diseased, the urine, besides albuminous matters and more or less of crystallisable sugar, often contains the saccharine principle in *imperfectly developed forms*. Hence such urine, almost without becoming perceptibly vinous, passes at once into the lactic or acetous fermentation ; and acquires, from the quantity of lactic and acetic acids developed, the strong acid smell of sour milk.‡

The following table, constructed by Dr. Henry, and partly interpolated by myself, shows the quantity of solid extract in sixteen ounces of urine of different specific gravities, from 1·020 to 1·050. In the experiments which furnished the data of this table, the urine was evaporated by a steam heat till it ceased to

* I have seen an instance in which the specific gravity of diabetic urine was as low as 1·010. This urine distinctly and rapidly underwent the vinous fermentation.

† Watt on Diabetes, pp. 47, 74.

‡ This phenomenon is often exhibited by the chylous urine, to be hereafter mentioned ; a disease in which the disorganising function of the kidneys is either destroyed, or suspended.

lose weight; and till it left an extract which became solid on cooling.*

This table enables us to ascertain with considerable precision the quantity of solid matter voided by a diabetic patient in a given time. Thus, suppose ten pints (old wine measure) are passed in twenty-four hours, of the average specific gravity of 1·040; it appears from the table that this quantity will contain 10×1 oz. 4 dr. 2 scr. 6 grs. = 15 oz. 7 dr. 2 scr.; or upwards of a pound and a quarter of solid extract.

TABLE.

Specific gravity compared with 1000 parts of water at 60°.	Quantity of solid extract in a wine pint. grains.	Quantity of solid extract in a wine pint, in oz. dr. scr. grs.
1020	382·4	0 6 1 2
1021	401·6	0 6 2 1
1022	420·8	0 7 0 0
1023	440·0	0 7 1 0
1024	459·2	0 7 1 19
1025	478·4	0 7 2 18
1026	497·6	1 0 0 17
1027	516·8	1 0 1 16
1028	536·0	1 0 2 16
1029	555·2	1 1 0 15
1030	574·4	1 1 1 14
1031	593·6	1 1 2 13
1032	612·8	1 2 0 12
1033	632·0	1 2 1 12
1034	651·2	1 2 2 11
1035	670·4	1 3 0 10
1036	689·6	1 3 1 9
1037	708·8	1 3 2 8
1038	728·0	1 4 0 8
1039	747·2	1 4 1 7
1040	766·4	1 4 2 6
1041	785·6	1 5 0 5
1042	804·8	1 5 1 4
1043	824·0	1 5 2 3
1044	843·2	1 6 0 3
1045	862·4	1 6 1 2
1046	881·6	1 6 2 1
1047	900·8	1 7 0 0
1048	920·0	1 7 1 0
1049	939·2	1 7 1 19
1050	958·4	1 7 2 18

* Annals of Philosophy, (Old Series,) vol. i. p. 27. Other tables of a more general and perhaps accurate character will be given in the Third Book.

A *saccharine* condition of the urine, as before observed, is the characteristic symptom of Diabetes; but another most striking and almost constant symptom present is *diuresis*. Diuresis exists in every possible degree; and sometimes the quantity of urine voided is enormous. Thus cases are on record in which thirty pints and upwards have been discharged in twenty-four hours, for weeks and even for months together. In such instances it has been said that the quantity of urine voided has been more than double the whole *ingesta*—a circumstance which physiologists have puzzled themselves a good deal to explain. I believe, however, that in the best authenticated cases, this enormous difference between the quantity of fluid taken, and of urine passed, has not been observed.*

The other symptoms, and general history of Diabetes, may be thus stated.

The commencement of diabetic attacks can seldom be accurately determined; but by inquiring minutely as to the period when the urine was *last observed to be turbid*, I have several times traced attacks very nearly to their origin. In such instances, patients have usually stated, that at some former period, the continued turbidity of the urine was such as to attract their observation; and on being questioned as to the supposed cause of such turbidity, some have ascribed it to exposure to cold; others to an attack of gout or rheumatism; others to disordered health from mental anxiety, &c. In most instances, the cessation of this turbidity was not accurately noticed; in a few, the termination was observed to take place rather abruptly; and the urine, on becoming clear, was likewise observed to become increased in quantity. Now it is probable that at the time the urine became clear, its saccharine condition commenced, or at least became confirmed; though, in general, the increased flow of urine was not so great, as to attract the patient's attention for several weeks; sometimes for several months, after this period. At the commencement, and during this early stage of diabetes, the fol-

* Watt on Diabetes, p. 158. Mr. M'Gregor, in the paper before alluded to, has shown that the weight of the *egesta* occasionally surpasses that of the *ingesta*; and refers the difference, as others have done, to absorption of fluid by the lungs. There is reason to believe that absorption of fluid in some cases takes place by the skin, as well as by the lungs.

lowing are among the most usual and prominent attendant symptoms.

In proportion as the urine becomes clear and copious, the mouth becomes clammy ; the tongue loaded with a white frothy mucus ; and the thirst increases. The appetite, nevertheless, remains unimpaired ; indeed, in general is better than ordinary ; yet the patient, to his surprise, daily loses flesh and strength ; and finds himself less and less adequate to his former exertions, both bodily and mental. At this time also he usually complains of chilliness, accompanied by dull pain and sense of fatigue in the back and loins, and in the lower extremities. The skin likewise becomes dry and harsh ; and the bowels more or less constipated. Such are the symptoms, with modifications, which usually present themselves in the early stages of diabetes ; and if the disease be now recognised and properly treated, its progress may in many instances be arrested ; or the disease, for the present, may perhaps be removed altogether. But if, as is unfortunately often the case, the patient neglects to apply for medical advice at this early period of the affection ; or if the nature of the disease be overlooked, and it be treated as a common affection of the general health, with blue pill, &c. ; all the symptoms soon rapidly increase, and the affection assumes the form of confirmed Diabetes.

In the second or confirmed stage of Diabetes, the quantity of urine is increased far above the natural standard ; and the thirst, and all the accompanying symptoms, increase in proportion. The mouth is constantly dry and parched ; the edges, and finally the whole tongue, become prternaturally clean and red ; the gums are often spongy, bleed readily, and by contracting from the teeth, leave them liable to become loose. There is a frequent uneasiness and heat in the region of the stomach ; accompanied by a sensation of sinking and faintness, and a consequent incessant craving after food and drink, which are taken in inordinate quantities. Still the thirst is not allayed ; nor the hunger satisfied ; nor the flesh nor strength increased ; on the contrary, the emaciation and debility progress rapidly ; the quantity of urine, particularly in cold and damp weather, becomes greater than ever ; and the person and breath of the patient often exhale a sweetish hay-like odour. Accompanying these bodily symptoms there is great de-

pression of spirits and despondency ; the once vigorous mind becomes feeble, oblivious, and vacillating—the once amiable temper, fretful, suspicious, and intolerant. The pulse, which had hitherto been but slightly affected, is now usually quicker than in health, and indicates debility. As the disease proceeds, disorganisation of some important organ, particularly of the lungs, commences or becomes active. In addition to the other symptoms, there are now flying pains about the chest ; the breath becomes short ; and there is more or less of cough and expectoration. This constitutes the last, and usually* the briefest stage of the disease. The emaciation and debility now rapidly approach the maximum ; the tongue and fauces assume a dark-red colour, and often become aphthous ; the urine generally diminishes in quantity, and loses much of its saccharine property ; the feet and legs become oedematous ; and, finally, after almost a total suppression of the renal secretion, the patient becomes comatose, in which state he expires.

Such is the history of Diabetes in its simplest form. We shall briefly illustrate some of the more prominent symptoms, with the view of pointing out their modifications and complications.

The *thirst* is an invariable symptom ; I have never seen it entirely absent ; but some suffer much more from thirst than others, even in the same stage of the disease. Thirst increases by indulgence in the use of fluids ; and those who drink most, invariably suffer most from this distressing symptom. The *appetite* is often capricious and deficient in the early stages of Diabetes ; and in a few instances is not inordinate at any period.

A *dry* state of the skin is one of the next most constant symptoms present in Diabetes. I have, however, seen many cases of confirmed Diabetes, in which this symptom was wanting ; and in which perspiration, and even profuse sweating, was induced by slight exercise. The same may be remarked of *constipation* of the bowels ; which is by no means always present in Diabetes. On the contrary, I have several times seen Diabetes accompanied by frequent attacks of *diarrhœa*. Even the *chilliness* so frequently complained of in Diabetes is not constantly experienced ; and cases occur in which the patient is almost insensible to the effects of cold, however intense.

The *red* state of tongue, and the sense of heat in the stomach, which usually accompany this symptom, frequently extend to the urinary organs; where it appears in the form of inflammatory redness at the external orifice of the urethra; and sometimes in the form of phymosis. These symptoms are occasionally among the first that have been noticed in diabetic individuals; while in other individuals they never appear at all.*

Emaciation and *debility* are almost invariable symptoms; yet Diabetes is not a disease peculiar to spare and feeble habits: for I have repeatedly met with it in individuals from whose appearance alone it would never "have been suspected; and in several instances I have seen Diabetes occur in unusually fat and powerful individuals. The first instance of this kind occurred to me in 1837. The patient was a middle-aged gentleman who had spent many years of his life in India, from whence he had returned, I believe, on account of bad health. About the period of his return he informed me that he weighed twenty-seven stone, or nearly three hundred weight and a-half! When he consulted me a few months afterwards, he weighed twenty-three stone. At this time he laboured under well-marked symptoms of Diabetes; the urine was large in quantity, and very saccharine; the thirst was most urgent; there was troublesome phymosis, &c. He was put on the plan to be presently detailed, and in a few weeks went on the continent. Shortly afterwards, at Aix-la-Chapelle, where he had used the baths, he was seized with a violent nephritic attack, with bloody urine, &c., apparently caused by a renal calculus; but none was observed. Nearly two years elapsed before I again saw him,

* This inflammatory irritation about the orifice of the urethra is often a source of great annoyance and suffering to females labouring under Diabetes; and in middle-aged individuals I have several times seen it among the first symptoms leading to a discovery of the disease. Indeed, whenever such irritation exists in corpulent women above the age of forty, the state of the urine should be carefully examined. An interesting case of this kind has recently occurred to me. A corpulent middle-aged lady had for several years laboured under severe irritation about the orifice of the urethra, &c., and for which almost every remedy had been resorted to by eminent practitioners both in England and France without success. The condition of the urine had never been inquired into or suspected, but on examination I found it in the highest degree saccharine, and from the history of the case, I have no doubt it had been saccharine for a long time.

when he informed me that he had rigidly adhered to my advice, and was quite well. His weight was now about twenty-one and a-half stone. The specific gravity of his urine was 1·030; it was free from sugar; abounded in the common lithate of ammonia sediments; and was natural in quantity. The thirst, phymosis, &c., had also left him. He was able to take a great deal of exercise, and shortly afterwards went again to India.* The second instance, which occurred about the same time, was that of an athletic gentleman about sixty, weighing upwards of seventeen stone. When I first saw him, the urine was much above the healthy standard, and very saccharine. He suffered also from constant thirst, &c. Under the plan prescribed, the urine soon became much diminished in quantity, and the thirst less urgent; and he felt little inconvenience from either. He also gained considerably in weight; though the urine still contained sugar. This gentleman died soon afterwards from an attack of erysipelas brought on by an injury of the head. Another instance of Diabetes occurred to me in an athletic and corpulent man, whom I have not since seen. I learn, however, from his friends, that he goes on without suffering much inconvenience; but whether the urine still remains saccharine, I have had no opportunity of ascertaining. I have also, as before observed, seen many instances of Diabetes in corpulent middle-aged females.

Debility is always present in Diabetes, particularly in the last stages of the disease; when both emaciation and debility often become extreme. These, however, as well as many other of the distressing symptoms of Diabetes, are obviously referable to the enormous drainage from the system, rather than to the mere saccharine condition of the urine. "The loss of so much matter from the system," as Dr. Elliotson justly remarks, "sufficiently explains the hunger; the feeling of emptiness and sinking in the stomach; the emaciation; debility; anaphrodisia; coldness of the legs; pains both of them and of the loins; the depression of spirits, &c., without attributing the disease to the stomach or kidneys exclusively. The excessive escape of fluid, or, when this

* In October, 1841, I received a note from this gentleman, who had again returned home. He informed me that he had experienced only one slight return of Diabetes, but was much annoyed with red gravel. I met him in the street in the summer of the present year, 1847, apparently well.

does not take place, the feverishness, equally explains the thirst and dryness of the skin."* That this is a just explanation is proved by the fact, that under a proper regimen, &c., most of these symptoms disappear along with the large flow of urine. To mention an extreme instance, I may state, that I knew a gentleman who long laboured under confirmed Diabetes, and who recovered so far as to marry and to have two children ; though the saccharine condition of the urine never left him. Indeed a saccharine condition of the urine exists in dyspeptic and gouty individuals much oftener than is supposed ; and hundreds pass many years of their lives, with this symptom more or less constantly present, who are quite unaware of it, till the quantity of urine becomes increased.†

With respect to the *terminations* of Diabetes ; phthisis, as already stated, is the most frequent. Besides phthisis, however, I have seen Diabetes prove fatal by disease of the liver and jaundice ; by apoplexy ; by a peculiar affection of the stomach, brought on by improper food, or by over-distension ; by acute gastritis induced by taking cold fluids when heated ; by inflammatory fever excited by exposure to cold, and rapidly assuming the typhoid character, &c. Occasionally Diabetes is said to terminate in incurable dropsy, and in various other affections. In short, a great many circumstances which would not affect a sound constitution, often prove fatal in this disease. As illustrations of the frail tenure of life and fatal results from slight causes in Diabetes, I may mention, that within the last few years, no less than four individuals have died from the fatigue and excitement incidental to a journey from the country to consult me. The first was a gentleman from the Channel Islands, who having suffered much from cold and sea-sickness during a boisterous voyage, died the next morning after he came to town. A second

* Numerous cases illustrative of the efficacy of hydrocyanic or prussic acid in affections of the stomach, &c., p. 90.

† As other instances of Diabetic derangement and debility, I may state that I have seen two cases of the disease accompanied by cataract. The one in a gentleman between fifty and sixty, (lately dead;) the other in a young man between twenty and thirty. The young man had been successfully operated on ; and when I last saw him appeared likely to recover his sight. I have also seen Diabetes accompanied by nervous deafness.

gentleman died before I saw him, almost immediately on his arrival at a friend's. A third very nearly died in my house. I happened to be from home when he called, and, unable to go further, he waited for me. I found him nearly speechless ; and it was only after the free use of stimuli that he rallied so far as to be able to say where his friends lived. To them he was immediately taken with every care, but he continued to sink rapidly, and died in a few hours. A fourth gentleman recently died soon after his arrival at home, apparently from the excitement of his journey to London. In all these different cases, it may be observed, that the individuals were in their ordinary state of health when they left home, and their deaths could be only ascribed to the fatigue incidental to travelling. Patients therefore, in the confirmed stages of Diabetes, should be cautioned against taking long journeys or otherwise fatiguing themselves ; particularly in very cold or in very hot weather. From these and from numberless other instances that could be mentioned, of the frail tenure of life in this disease, it follows that in confirmed Diabetes, patients exist as it were on the brink of a precipice ; and that the general prognosis in the confirmed disease, must be considered as unfavourable.

Causes.—It is a remarkable fact, that Diabetes seems to be peculiar to mankind. Horses and other animals are indeed subject to diseases accompanied by a large flow of urine ; but I am assured that in such cases the urine is never saccharine ; nor am I aware that sugar has been found in the urine of any inferior animal. If such an immunity from Diabetes really exists among the inferior animals, its cause is very obscure. Can the exemption be referred to the absence of that fertile cause of bodily disorder in human beings, the influence of *mind* ?

A *predisposition* to Diabetes is, I believe, much more frequently *inherited* than *acquired* ; I have seen repeated instances of such an inherited, and family tendency ; and the circumstance has been noticed by others ; so that I do not think it necessary to enter into details on this point. Other causes predisposing to this affection may be classed under the heads of *temperament*, *sex*, and, *age*. Thus I have seen more cases of Diabetes in individuals of the sanguine temperament with light or reddish hair, than in any other. The disease, however, occurs in all temperaments ; and perhaps next in frequency to the sanguine, in the melancholic

temperament. In strumous individuals, with dark hair and eyes, fair skin, &c., Diabetes often assumes its most unmanageable and fatal form. Diabetes is less frequent in women than in men; and rarely occurs in infancy or in old age. There is, however, a modification of Diabetes occasionally occurring in very young children, to which the attention of the profession was first distinctly drawn by Dr. Venables; and of which we shall presently speak.*

A *predisposition* to Diabetes may, however, be *acquired* as well as inherited; and that perhaps by a variety of causes. To some of these causes we have before alluded; and it is only necessary to mention here, that a predisposition to this affection seems to be occasionally acquired by a residence in a cold and damp situation, or in a malarious district, particularly if at the same time conjoined with a poor and unwholesome diet, or the too free use of sugar, &c.; also by venereal excesses; by the abuse of mercury; and, in short, by any cause having a tendency to sap the foundations of organic life; and more especially of the processes of assimilation.

The *exciting* causes of Diabetes have not been so clearly ascertained as could be desired; but it is probable that when a strong predisposition to the disease exists, a variety of slight circumstances will bring on the affection. The most frequent exciting causes that have fallen under my own notice, have been exposure to cold; attacks of rheumatism and of gout; the drinking of cold fluids while heated; mental anxiety or distress arising from a variety of causes, such as a sudden reverse of fortune; &c. Other causes assigned by authors have been the too free use of diuretic and diluent fluids, as cider. Also concussions or injuries of the back, from hard riding; or from falls, strains, &c. Another class of causes, or rather of concurrent diseases, are various affections of the cutaneous and cellular tissues. I have seen several instances referable to this class; and were I permitted to draw a general inference from my experience, I should say, that Diabetes usually *follows* cutaneous affections; and accompanies (perhaps *precedes*)

* See a Practical Treatise on Diabetes, &c., by R. VENABLES, M.B., &c. Some time ago, by favour of Dr. Macintyre, I saw a case of true saccharine Diabetes in a girl five years old. The specific gravity of the urine was once as high as 1·045, and the disease ran its course rapidly and proved fatal in a few weeks.

the affections of the cellular tissue. Thus I have several times heard patients observe, that they were formerly subject to eruptions in various parts of the body, but that such eruptions disappeared after the diabetic complaint became established; nor do I remember more than three or four instances, in which Diabetes actually accompanied a severe cutaneous affection.* On the contrary, Diabetes very frequently (as far as my personal experience goes, *always*) accompanies carbuncles, and malignant boils or abscesses allied to carbuncles. This is a fact mentioned by several of the old writers;† and is of great importance to surgeons, who usually have the management of these affections. Some years ago, an interesting case of this kind occurred to me. The patient was a middle-aged man, who told me that for a long period he had been subject, at intervals of a year or two, to boils, one of which, generally on the back or neck, assumed the form of carbuncle; and that, during such attacks, he always passed a large quantity of saccharine urine. When I saw him, he was recovering from one of these carbuncular suppurations; and the urine was copious and very saccharine. I lost sight of him soon afterwards, and am therefore unable to state whether the urine, in the interval of the attacks, recovered its healthy character. He repeatedly assured me, however, that its quantity, after a certain time, always became quite natural. I have also many times found sugar in the urine of individuals labouring under severe chronic disease of the bladder and prostate gland.

The *proximate* cause of Diabetes has puzzled Physiologists; and a great deal has been said and written on the subject, which it would be useless to repeat here. If the principles advanced in this volume be well founded, the proximate cause of Diabetes may be at least as intelligibly explained, as the proximate cause of any other disease.

The *Diagnosis*, for the most part, is sufficiently easy in Diabetes. When the urine of an individual is *constantly* of a pale

* In two of these cases, the cutaneous affection appeared to act as a safety valve, and the patient lived for many years with Diabetes in its most decided form. In one of these cases the cutaneous affection was of an impetigenous character, and chiefly affected the legs; in another Lepra, and dispersed largely over the body.

† See Cheselden's Anatomy, p. 139. Fifth Edition.

colour, transparent, and of a specific gravity of 1·030 or upwards, the presence of Diabetes may be suspected, even though the *quantity* of the secretion may not exceed the standard of health. If the properties of the urine above mentioned be *occasional* only, Diabetes may or may not be present; and in this and in other doubtful cases, recourse must be had to the means pointed out in the Third PART of this volume, for determining the presence or absence of sugar in the urine.

The general *Prognosis* in Diabetes must, as already stated, be considered as unfavourable.

Among the *favourable* symptoms in this affection may be enumerated, a moderate flow of urine of a specific gravity not higher than 1·035; the appearance in the urine of lithic acid, either in its amorphous or crystalline form; the recent appearance of the disease, and absence of thirst; the retention or gain of flesh and strength; and more than all, immunity from organic disease, especially from organic disease of the lungs. On the contrary, when the flow of urine is permanently excessive, and of high specific gravity; or when this secretion is pale coloured, opalescent, and serous; when the thirst, emaciation, and debility are extreme; or when organic disease, particularly of the lungs, is present, the chance of recovery is much diminished. But when, as is too frequently the case, several, or all of these unfavourable symptoms co-exist; the chance of recovery is not only diminished, but *absolutely hopeless*.*

The *post mortem* appearances throw little satisfactory light on the nature of Diabetes. As may be inferred from what has been

* Within the last thirty years, I have seen more or less of nearly seven hundred instances of diabetes; and of this great number, as far as minor and concomitant symptoms have been concerned, no two cases have been exactly alike, or have been benefited by exactly the same treatment; so greatly diversified is this apparently simple form of disease. The disease has occurred to me in one instance in a child only five years old; and about a dozen times in young persons between eight and twenty years of age, of whom four were females. Of these dozen cases, not one has lived to grow up; and the greater proportion have died in various ways, after a comparatively short course of the disease. With respect to the *duration* of Diabetes; I know, *at present*, but two instances in which the affection was clearly ascertained to exist in its perfectly developed form ten years ago. As stated in the text, however, I believe the disease sometimes exists for many years in its incipient stages.

stated ; in different instances, different organs have been found affected ; while, in other instances, scarcely a trace of disease has been discovered in any organ. Thus, besides the lungs, which are the organs most generally affected, I have seen, in different individuals, the liver, the mesenteric glands, the prostate gland and bladder, and one or both kidneys, in a state of organic disease ; while, in other individuals, each and all of these organs have been observed to be apparently sound. Such diversity in the organs affected, and particularly the occasional absence of *all* organic disease, seem to render it probable, that the presence of sugar in the system neither necessarily depends on, nor produces visible organic lesion of any particular organ ; but that organic diseases, when they do exist, are merely concurrent affections. This inference is still further corroborated by the fact, that sugar is constantly passing through the sanguiferous system in Diabetes, without producing any very striking disturbance, much less *organic* disease.* This remarkable peculiarity of the saccharine principle probably arises less from its mild and innoxious character, than from its great solubility in water. Did sugar possess active properties ; or were it as insoluble as the albuminous principle ; there can be little doubt that the constitutional disturbance produced by it would be much greater ; and that organic disease would be a more frequent consequence of its presence in the blood.

The most constant diseased appearances I have noticed after death in diabetic individuals have been rather of a chemico-mechanical nature, than strictly organic. These diseased appearances may be comprised under the following three heads : First, an enlarged, flaccid, and occasionally a congested state of the kidneys : a section of which organs, when first removed from the recently dead body, has frequently assumed, on exposure to the air, a peculiar deep orange-red tint, difficult to be described ;† Secondly, a gorged condition of the veins terminating in the portal system, particularly of the veins of the mesentery ; and an unusually dark-

* Functionally speaking, I am induced by long attention to believe that the liver is always deeply involved in Diabetes. This point will be briefly considered in the Third Book.

† In several recent instances this peculiar tint has been entirely absent.

coloured and fluid condition of the venous blood throughout the assimilating organs; Thirdly, but not so constantly, a vascular state of the mucous membrane of the stomach, and upper portion of the alimentary canal.

Treatment.—The treatment of Diabetes proposed by authors has been as various as their opinions respecting its nature; and perhaps there is no disease in which so much mischief has been done on false principles, and by random experiment, as in this. The facts and observations I have to offer on the subject, are founded on the opinion already advanced, viz., that Diabetes is nothing more nor less than a form of dyspepsia; that this dyspepsia principally consists in a difficulty of assimilating the saccharine alimentary principle; and that, like all other forms of dyspepsia, whether it be an inherited or an induced affection, Diabetes is liable to be much modified and aggravated by concomitant circumstances.

In a practical point of view, Diabetes ought always to be considered in a twofold light; as a simple saccharine condition of the urine, without any increase in its quantity; and as complicated with a preternatural flow of that secretion. Want of attention to this simple distinction has caused great confusion in the history of the disease; and substances in consequence have been extolled as remedies, which have acted simply by diminishing the flow of urine and its consequences, without altering in the least degree its saccharine condition. Whether there be any remedy that exerts a specific action in improving the qualities of the urine, is exceedingly doubtful; certainly, at least, there is none at present known. If, therefore, the qualities of the urine be improved at all, they must, I think, be improved through the medium of those remedies that have a tendency to diminish the quantity of the urine, and to restore the general health. At any rate, these are necessary as preliminary steps; for it seems to be quite absurd to look for any improvement in the quality of this secretion, while its quantity remains unnatural.

The first and chief point to be attended to in the treatment of Diabetes is *diet*; under which head are included both solid and liquid aliments.

For some years past, a diet exclusively animal has been much insisted on in this disease; and, from the principles we have at-

tempted to establish, it will be readily understood that an animal diet ought to form an essential principle in the treatment. I do not, however, approve of a diet exclusively animal; but consider a certain proportion of *vegetable* matters proper. The vegetable matters to which I particularly here allude, are the *green portions* of plants. The reasons for this recommendation will be presently stated. With regard to farinaceous matters, I have lately prohibited them altogether in the confirmed stages of Diabetes. As the disease, however, recedes, I still think it proper to gradually introduce the use of farinaceous matters. It is difficult to find a substitute for bread; and in a subsequent note a process is given for making a species of bread without farinaceous matter. The recommendation of this admixture of farinaceous matters is founded on a fact elsewhere alluded to, and apparently well established, viz. that the assimilation of the saccharine principle is one of the last functions that becomes extinct in animals. The introduction of farinaceous matters must be gradual, and be varied according to the degree in which the patient is able to assimilate albuminous, in preference to farinaceous matters; a point not difficult to be determined by a little attention. Of farinaceous matters, the *high* or *strong*, as the farina of wheat in the shape of unfermented bread, or biscuits, appear to be most easily assimilated. The *low* kinds of farinaceous matters, as arrow-root, potatoes, &c., (with the exception perhaps of rice,) seem to be more easily reduced to sugar than the farina of wheat, and in general, therefore, should be avoided. Every variety of the saccharine principle in its *crystallisable* form, is absolutely inadmissible as an article of food in Diabetes. This rule excludes therefore, at once, all fruits, whether subacid or sweet; as well as every compound, natural or artificial, into which sugar enters. The practical importance of this rule is so great, that I am doubtful, if it be neglected, whether good can be obtained from any plan of treatment. Even its occasional infringement cannot be indulged with impunity. Thus I have known the use of a few saccharine pears undo, in a few hours, all that I had been labouring for months to accomplish; and the disease, with all its horrors, has become re-established in an aggravated form. In the use of all prohibited articles, Dr. Johnson's saying with respect to himself, viz. that he found it

easier to abstain than to be abstemious, should be constantly kept in view. In general, therefore, in diabetic cases, it will be much better to prohibit altogether the use of doubtful articles, than to allow a little of them to be taken: for the latitude which inclination gives to the term *little*, and the want of stoicism to resist, are certain to lead to abuse and all its consequences.

A point to be attended to, of fully as much importance as the qualities of diet, is its *quantity*. The constant craving for food which is generally present in this disease, is liable to induce the patient to take by far too much at one time; the consequences of which are not only unflavourable to his recovery, but sometimes dangerous, and even fatal. Indeed, I believe the greater number of cases of sudden death in Diabetes (which is by no means an uncommon termination of it) have been distinctly referable to errors either in the quality or quantity of the food, or to both; that is, the patient has been usually cut off after a *hearty meal*, as it is vulgarly termed. As a general rule with respect to diet, it may be said, that a quantity, greater or less according to circumstances, but always strictly regulated, should be taken at periods of four, five, or six hours; and that at the time of taking solid food, and for an hour or two afterwards, all fluids should be abstained from as much as possible. Were I to particularise the species of food, I should say, generally, that mutton or beef, plainly cooked, and particularly mutton-chops or beef-steaks, rarely done, should be taken twice in the twenty-four hours; and that the other meals should consist of any simple article that can be prepared from milk, eggs, butter, &c., only.* The recommendation of this *solid* plan of diet is chiefly founded on the well-known fact, that the *reducing* or *dissolving* function of the stomach is unimpaired

* For the composition and preparation of a substitute for bread, the reader is referred to a future page. We may observe here, that oleaginous matters often agree so remarkably well in Diabetes, that some have gone so far as to propose them as remedies. When freely taken, they usually cause a flow of saliva, and thus diminish the urgent thirst. When they agree, also, they give a sensation of satisfaction and support to the stomach, which other alimentary substances do not. Perhaps butter is the most agreeable form in which they can be taken; and this, under proper circumstances, may be taken freely. When oleaginous matters disagree, as is sometimes the case, they should be carefully shunned.

or morbidly active in Diabetes. When the reducing function is impaired, as happens in a few instances, a system of diet less solid, and consisting of animal matters reduced to the pulpy state by stewing after the French fashion, will be more appropriate.*

Many of the remarks above applied to the use of solid matters apply equally to the use of fluids ; that is, the quantity and quality of the fluids taken in Diabetes must be carefully attended to ; otherwise benefit can scarcely be expected from any plan of treatment. So urgent is the thirst, and so great in general is the mental imbecility and want of stoicism *in diabetic individuals, that they will often drink by stealth, when they cannot for shame, or want of opportunity, do it openly. The management of drinks, therefore, in the treatment of this disease, often becomes a point of considerable difficulty ; and, as a certain indulgence must be allowed, it becomes necessary to consider those drinks of which the least quantity is likely to be taken by the patient ; and from which, at the same time, least harm may be probably expected.

The Bristol Hotwell, and other waters containing carbonate of lime in solution, have been long celebrated in diabetic affections ; and, as Dr. Marsh observes, they appear to quench the thirst in such affections better than most other mere diluents.† Allicd to these are waters artificially impregnated with lime or magnesia ; as lime-water, which, either alone, or with milk, has been a favourite remedy in Diabetes with some writers ; the same may be said of water containing magnesia held in solution by carbonic acid, &c.,‡ Waters containing fixed alkalis, and their salts, are generally too diuretic in their effects to be recommended in this affection ; yet when saturated with carbonic acid gas, and held in

* We have omitted to notice the effects of *gum* as an aliment in diabetic affections. From the chemical properties and analogies of this principle, it is probable that it is not so readily converted into sugar or oxalic acid, as farinaceous matters. I am not yet able, however, to state the effects of gum as an aliment in diabetes so satisfactorily as I could wish : and have therefore omitted to touch on the subject.

† Dublin Hospital Reports, vol. iii. p. 430.

‡ We have lately heard of diabetes being *cured* by the free use of the Vichy waters ; also by a liberal allowance of French wines conjoined with an animal diet, &c., but I have had no opportunity of verifying these reports.

the mouth for a few seconds without swallowing them, they often remove or mitigate thirst better than most other fluids. All the stronger saline waters, from their diuretic properties, should be carefully avoided. As a simple diluent, I am disposed to think very highly of distilled water. The use of water, however, in all its forms, should be sparingly allowed, as it is exceedingly liable to be abused ; and various animal decoctions, milk, &c., should be taken instead. When the patient has been in the habit of taking fermented liquors, I have been accustomed for some years past to recommend sound porter in preference to wine or spirits.* The quantity must be determined by the circumstances of the patient ; but the minimum quantity should be rarely surpassed. With some exceptions, I have seen more relief from thirst, and more support given by porter in diabetic cases, than by any other similar means. As general rules, also connected with the subject of fluids, it may be observed ; first, that as the sudden abstraction of fluids in diabetic cases is sometimes followed by unpleasant consequences, the quantity should be gradually diminished ; secondly, that in order to induce the patient, whose craving is generally after *cold* drinks, to take as little as possible, all fluids should be recommended in a *tepid* state ; and lastly, that fluids should be taken at those periods in preference to others, when the stomach is not loaded with solid food.

With respect to the employment of aliments containing matters incapable of being assimilated and intended only for *excremental*

* The marked differences often produced by porter and common ales in Diabetes and Dyspepsia in general, I have been accustomed to refer to the different states in which the saccharine principle exists in the malt of which they are prepared. In the manufacture of malt designed for making ales and other pale-coloured liquors, the heat employed is barely sufficient for the purpose of exsiccation. On the contrary, the heat employed in the manufacture of malt designed for making porter, is so great, as to modify, if not to decompose, a large portion of the saccharine principle, and thus to render it more easy of assimilation. Whether this explanation be admitted or not, the fact is undoubted, that many dyspeptic individuals can assimilate porter, who, from the symptoms they produce, cannot assimilate the sweeter ales. Some of the finer kinds of Burton ale, however, are unobjectionable ; particularly those prepared for the Indian market, which are not only carefully fermented, so as to be quite *dry*, or free from saccharine matter ; but they also contain double the usual proportion of hops.

purposes; we offer the following observations once for all; that is, as not only applicable to Diabetes, but to all the most common forms of dyspepsia, accompanied by constipation and irregularity of the bowels.

Excremental matters may be classed under three heads; first, matters incapable, under any circumstances, of being assimilated; secondly, matters capable of being assimilated, but which, on account of some derangement of the system, are only partially or imperfectly assimilated; and thirdly, superfluous alimentary matters, not required by the economy at all, and therefore not assimilated. On each of these we shall make a few remarks.

First, with regard to matters incapable of being assimilated, we need scarcely observe, that those matters only are included under this head which usually form a natural constituent of common aliments; such, for instance, are the principle termed *lignin*, and the green colouring matter of the leaves of plants, in all their numerous forms and varieties, among vegetable aliments; and the cartilaginous and incidental mineral matters among animal aliments.

In those forms of dyspepsia, and more especially in Diabetes, in which the reducing powers of the stomach are morbidly active, so that every soluble substance is immediately acted on, and withdrawn from the alimentary canal, the bowels are apt to become unusually torpid; unless provision be made to take with the food a certain proportion of matters incapable of solution; but which, at the same time, while they gently stimulate, do not over excite, or otherwise derange the functions of the alimentary canal. Among matters suited for such a purpose, none, perhaps, surpass the vegetable proximate aliment termed *lignin*; a modification of the saccharine principle, which, though readily dissolved by the stomachs of some of the inferior tribes of animals, resists in general, and in all its forms, the powers of the human stomach. Of the numerous shapes assumed by lignin, the best adapted for excremental purposes is undoubtedly the external covering of the seeds of the *cerealia*, and particularly of wheat. Bread, therefore, made with undressed flour, or even with an extra quantity of bran, is the best form in which farinaceous and excremental matters can be usually taken in most of the varieties of dyspepsia, accompanied by obstinate constipation. This is a remedy, the efficacy

of which has been long known and admitted ; yet, strange to say, the generality of mankind choose to consult their taste rather than their reason ; and by officiously separating what nature has beneficently combined, entail upon themselves much discomfort and misery. *

In stating above, that *most* individuals subject to constipation obtain relief by the use of brown bread, I wish to imply, that there are some exceptions ; and that not only among the various forms

* For some time past, I have recommended as a substitute for bread in diabetes, a compound of bran, eggs, and milk, which if properly prepared is not unpalatable. The late Rev. J. Rigg, to whom this *bran-bread* was recommended, took much pains to perfect the process, and the following, with some slight variations, is the method he finally adopted.

The bran in the first place is to be reground, or the coarser portions separated by sifting. It is then to be diffused through cold water, and permitted to stand for a short time so as to allow all the heavier portions, and particularly the silicious matter derived from the mill stones, to subside to the bottom. The bran suspended and diffused through the water, is now to be poured into a bag made of cloth, of such a texture as to allow the farinaceous matter, but not the bran, to escape through it ; and the bag with its contents are to be repeatedly washed in cold water till the water is no longer rendered milky ; in other words, till the whole of the farinaceous matter is removed. The bran is then to be removed from the bag, dried before the fire or in the sun, and after being well beaten and separated, again sifted ; when it will be fit for use.

Seven eggs, one sixth of a pound of butter, the same quantity of suet, (previously melted together,) and a pint of milk are then to be well incorporated and mixed with as much of the prepared bran as will make a soft dough, which is to be well kneaded in the ordinary way. The quantity of dough thus prepared will make four or five small loaves or cakes, which may be baked in saucers in a quick oven.

According to Mr. R. " This bread kept well and remained very palatable for a few days, and having it," he observed, " I really did not feel the want of any other kind of bread." He sent me a specimen, which arrived in good condition, and corresponded with his account. The addition of a few caraway seeds may by some be deemed an improvement. I regard this bran-bread as much superior to the *gluten*-bread recommended in Diabetes ; all the specimens of which I have seen have been difficult of mastication, in short, almost as much so as caoutchouc. It is probable that a superior bread may be made by a due admixture of bran, prepared as above, with gluten ; and that the lightness may be increased by employing the carbonate of soda and muriatic acid, as in the preparation of unfermented bread. In this case the milk may be omitted, and the bread made to resemble more nearly common bread.

of dyspepsia, but even in Diabetes. In such instances, the mucous membrane of the stomach and intestines is often so irritable, that the mechanical excitement produced by furfuraceous matters cannot be borne ; and in a few of such instances, (not in all,) the second great class of excremental matters, those, namely, consisting of the green matter of the leaves of plants, are sometimes found to be most useful. The green matter of plants is in general little acted on by the stomachs of the higher animals ; and hence may in most cases safely form a portion of the food of diabetic individuals, as first, I believe, recommended by Dr. B. G. Babington ; though on very different principles. • In many cases of common dyspepsia also, more especially connected with derangements of the lower intestines, and with irritable states of the mucous membrane ; the green matter of plants contributes, as above mentioned, to the action of the bowels by its excremental properties. In dyspeptic affections, however, more immediately connected with the stomach, it is apt to disagree by producing acidity and flatulence, and their consequences ; and as such forms of dyspepsia are by far the most common, herbaceous vegetable matters in general are much less suited for dyspeptic individuals, than farinaceous.* Other excremental matters, consisting chiefly of modifications of the lignin principle, are the fibrous or membranous coverings of many seeds and fruits ; as of the grape, apple, &c., all of which are insoluble, and contribute by their mechanical stimulus to promote the action of the bowels. On the same principle, also, the mustard seeds so generally recommended a few years ago, appear to act ; although it is probable, that in this case, the stimulating properties of the mustard may likewise contribute its share in producing the desired effect.

Among animal aliments, the tendinous and cartilaginous fibres and membranes form the chief of organised excremental matters. These matters are capable of being acted on to a considerable extent, when the reducing energies of the stomach are strong, as in

* From a careful attention to these points for some time past, I am persuaded that green vegetables, not only exert a beneficial action in diabetes and other forms of dyspepsia ; but that they can be taken with impunity in almost all cases, provided the patient abstains from drinking while taking them. It is the fluid that is taken with them, that more than anything else causes acidity and flatulence.

cases of unusual abstinence or starvation ; but under the ordinary circumstances of satiety in which mankind in a state of civilised society usually exist, such matters escape solution altogether, and consequently pass off as excremental matters. Viewed in this light, however, they appear to be vastly inferior to the lignin principle ; not only on account of their less excitent powers, but from the difficulty there is of comminuting them ; on which account they are apt to be swallowed in masses, which embarrass and impede the operations of the intestinal canal, rather than promote their due performance. With respect to the incidental mineral elements of organised products ; from the small proportion in which most of this class of matters exist in common articles of food, and from the facility with which they are dissolved in the acid secretions of the stomach, &c., such matters rarely appear as excremental principles. In substances, indeed, in which earthy matters form a larger proportion, as *in bones* ; the earthy matters are found among the excrements ; but from the difficulty with which such matters are pulverised they are scarcely adapted for, or employed as human aliments ; and are confined to the carnivorous classes of animals, whose teeth are expressly made to reduce them to powder. In the condition of powder, the solvent powers of the stomach, in this class of animals, appear capable of removing their nutritious portion from the mere earthy matters, which thus constitute the natural excremental matters in carnivorous animals ; in the same way that the different varieties of lignin and the green principle of plants form the chief excremental matters of vegetable feeders ; and even of man himself.

The second great class of excremental matters, those, namely, capable of being assimilated, but which, from some defects in the digestive processes, are only partially or imperfectly assimilated, requires very few remarks. Indeed this class of excremental subjects is so mixed up with the third class mentioned, viz., superfluous alimentary matters, or alimentary matters taken in excess, and not digested, because not required, that the little we think it necessary to say regarding both classes is given in conjunction.

A stomach habitually weakened from any cause, and particularly from overwork, when oppressed with a variety of superfluous aliments, naturally selects for its operations those matters most

easily assimilated ; while the remainder are either partially, or not at all touched, according to circumstances. In such cases, the imperfectly or unchanged matters become excremental ; and often by their unnatural properties produce great derangements of the alimentary canal, and more especially of the functions of the cæcum and colon—derangements which, independently of local discomfort, sometimes give occasion to remote and severe sufferings ; instances of which will be given hereafter. Nearly the same remarks are applicable to the class of superfluous aliments, which are not assimilated, because not required. • Indeed, as we have stated, this class differs little from the preceding, except in degree ; that is, the excremental matters contain a larger proportion of unassimilated matters ; or, in some instances, consist of little besides. It is proper to observe, before concluding these remarks, that the effects produced under the above circumstances differ remarkably, according to the degree of activity and irritability of the assimilating organs. If the stomach be active, and perform its part of the duty, the superfluous matters are more or less assimilated and pass into the system ; where, by contributing to plethora and congestion, more especially of the abdominal circulation, they give occasion to bilious attacks in all their forms and varietics. If, on the contrary, the primary assimilating organs be weak, and at the same time irritable or sluggish, derangements of the *primaæ vix* and their consequences result. If the bowels, for instance, be irritable, distressing diarrhoea, &c., takes place ; if sluggish, obstinate congestion of the bowels and costiveness arise. Lastly, if the bowels be passive, or at least are neither irritable nor sluggish, as is often the case in middle-aged strumous individuals ; unassimilated matters pass off almost in unlimited quantities without producing much inconvenience. Such individuals usually constitute the enormous eaters alluded to in a subsequent chapter ; the imperfect action of whose assimilating organs requires extraordinary support to enable them to subsist.

The system of diet and regimen generally applicable in Diabetes has been laid down in the first place, because it contributes more directly, perhaps, than any other means we possess, towards the attainment of the two great desiderata in the treatment of the disease, viz., the diminution of the quantity, and the improvement of the quality of the urine. The adaptation of this system of

diet and regimen to particular cases and complications, may be inferred from what follows respecting the medical treatment of the affection.

We have already stated, that no specific remedy is known for the essential symptom of Diabetes; in other words, we can no more directly restore the paralysed function of the assimilating organs, than we can directly restore the paralysed function of an arm or of a leg. The medical treatment of Diabetes, therefore, must be conducted on general principles; and consequently must not only be varied according to the degree and complication of the affection; but according to the general state of health and the peculiar constitution of the patient.

In cases of recent occurrence, and of an acute character, there cannot be a doubt about the propriety and even necessity of general *blood-letting*; which may be repeated as often as the circumstances of the case may seem to require. In very protracted cases, however, occurring in old subjects; and indeed, whenever the debility is excessive, this remedy can be seldom required: though even in such cases it has been shown that blood-letting can be borne much better than could be expected. In most cases, also, frequent local bleedings from the epigastric regions have been found beneficial; particularly when an extraordinary sense of fulness, heat, or tenderness, has been experienced about the region of the stomach.

Another powerful class of remedies is *purgatives*; from the active use of which, some have stated that much benefit may be derived. Purgatives certainly diminish the quantity of urine, for the obvious reason, that they divert the fluids of the body into other channels; but I have seen no permanent benefit from their employment with this intention. The occasional use of active purgatives may be proper, and even necessary; but as a general rule, according to my experience, purgatives are most beneficial when their use is limited to the regulation of the bowels. Of the remedies belonging to the purgative class, castor (or olive) oil, upon the whole, is perhaps the best adapted for general use. When oil is objected to, rhubarb may be substituted. If more active purgatives be required, care should be taken to select those which are least likely to act as diuretics as well as purgatives. Hence, with the exception, perhaps, of the phosphate of soda, the whole

class of saline purgatives may be generally considered as excluded in Diabetes.*

Another important class of remedies in Diabetes, are those which determine the fluids of the body to the surface. The dry and unperspirable state of the skin in this disease naturally suggested the use of diaphoretics, as they are termed, at an early period; and when such remedies can be brought to act favourably, they no doubt contribute much to the comfort of the patient, by removing one of the most distressing of the morbid train of symptoms. Among the most efficient remedies of this class may be mentioned the use of warm clothing, and particularly of flannel next the skin; frictions over the whole body with the flesh-brush; the use of the warm or vapour bath, &c. In conjunction with these, Dover's powder, antimonials, sulphur, camphor, &c., may be given internally in various doses and combinations, according to the circumstances of the case; or according as the stomach of the patient will tolerate them.

Other important classes of remedies, sometimes of the greatest utility in the treatment of Diabetes when judiciously applied, are sedatives, astringents, tonics, and antacids. Of sedatives, opium claims the first place; and in acute cases, after the most urgent symptoms have been subdued by bleeding or purgatives, and in almost all chronic cases, opium, either alone or in the form of Dover's powder, is one of the most useful remedies we possess. Generally speaking, the form of Dover's powder or the compound tincture of camphor, constitute the preferable modes of giving opium; on account of their determining the fluids to the skin, at the same time that they allay irritation. In a few instances, however, crude opium, and even salts of morphia, interfere less with the functions

* The action of diuretics is at all times uncertain and capricious, even in Diabetes. Thus I have known a patient labouring under this disease in its worst form, drink largely of the Leamington waters, without increasing the quantity of his urine; and even with some apparent improvement of his health. The effects could not in this case be referred to the purgative effects of the waters, for his bowels were only moderately excited. Similar remarks might be made with respect to other remedies which no one would think of recommending in this disease. On the contrary, so capricious is the action of the kidneys, that a remedy—for instance, opium—which rarely fails to diminish the quantity of urine, will occasionally act as a powerful diuretic.

of the stomach, than Dover's powder, &c. ; and consequently are better adapted to such instances. While I thus willingly admit that opium is one of the best remedies we possess for many of the symptoms of Diabetes, I cannot help observing, at the same time, that those who have announced it as a *cure* for the disease, have much overstated its powers. I have seen opium freely given for a great length of time, with the effect certainly of reducing the quantity of urine almost to the healthy standard, and of removing many of the more distressing symptoms ; but never with the effect, even approximately, of removing the saccharine condition of the urine ; nor do I believe opium possesses any such power. Moreover, there is this bad effect apt to be produced by such prolonged use of large doses of opium, that the patient becomes an opium-eater, and cannot exist without it. Indeed, when the opium is withdrawn, particularly if suddenly withdrawn, all the symptoms of the disease usually return ; sometimes with increased violence. Sedatives are often advantageously combined with astringents and tonics in the chronic forms of Diabetes. Thus, opium may be associated with tannin, or with its modifications, catechu and kino ; also with the mineral acids, and particularly with the sulphuric acid, either alone or in combination with quinine, iron, zinc, copper, or alumine. I have occasionally had recourse to all these combinations ; but in general have preferred the supersulphate of quinine or of iron ; and at the same time made it the rule to do with as little opium as possible. The blue phosphate, carbonate and citrate of iron, are also excellent remedies. Of the phosphate of iron in particular I am disposed to think very favourably ; but I have been disappointed with the use of the phosphoric acid ; which has not in my hands produced the good effects some have ascribed to it ; even when very freely and perseveringly administered. The nitric or rather the nitro-muriatic acid has been also much recommended and is often useful.

In some forms of Diabetes, accompanied by a white tongue and much acidity of the urine, with a deposition of lithic acid, ant-acids are useful. I have found magnesia one of the best. It may be given in doses of from gr. xv. to gr. xxx. two or three hours after breakfast and after dinner, in a little aromatic water. It often abates the thirst in a singular degree. Ammonia and its various salts, particularly the acetate and citrate, exert in many cases a

highly beneficial effect in Diabetes. They may be conjoined with the salts of iron, the stimulating effects of which they have a tendency to moderate.

Besides these, a variety of other remedies, not referable to either of the preceding classes, have been employed in Diabetes. Indeed, it has been too much the fashion, as already stated, to try at random new remedies, particularly if potent; the novelty and the potency of a remedy, without reference to its properties, being deemed sufficient to authorise a trial of it in this disease. To enumerate all the remedies that have been employed on these, or other grounds, would be quite out of the question. Among the most recent and active may be mentioned creosote, hydrocyanic acid, colchicum, strychnine, the hydriodate of potash, the sulphite of ammonia, &c. All these, and various others, have been recommended, either publicly or privately, as remedies for Diabetes; and on the faith of such recommendation I have myself tried a few of them; but I cannot say with any extraordinary success. Like many other remedies, some of them, as, for instance, creosote, have sensibly diminished the quantity of urine, and its immediate consequences; but here their good effects have ceased; and, as already stated, neither these nor any other remedies that have been yet proposed, exert, to my knowledge, any direct effects in improving the saccharine quality of this secretion.

When Diabetes, as is frequently the case, is complicated with other diseases, the nature of these complications must be taken into account, and the treatment adjusted accordingly. The complications usually existing in the early stages of the affection are by far the most important; for when the accompanying disease is recognised, there is often a possibility of averting, by its means, the diabetic affection itself; whereas a single false step at this early period may determine the fate of the patient, by developing the saccharine disease in its confirmed state. The most usual complications of Diabetes in its latter stages are, as we have stated, affections of the lungs, or some other equally formidable organic lesion. Even when such affections are present, and when, in consequence, the chance of giving permanent relief is greatly diminished, or altogether absent, it is still possible to do a great deal of mischief by injudicious treatment; and thus to hasten the fatal termination of the disease.

A frequent complication in the earlier stages of Diabetes is hepatic disorder, or disease. The consideration of such a combination of diseases naturally introduces the subject of *mercury*; on the free and too often indiscriminate use of which important remedy in diseases of the assimilating organs, I shall make a few remarks.

The extraordinary and immediate benefit often afforded by mercury in common affections of the assimilating organs, is one of the great sources of its abuse. Medical men know they can produce by its means, a certain off-hand effect; and to save themselves trouble, and at the same time to gain the doubtful reputation of being decisive and quick in their practice, they resort to mercury without due regard to its remote consequences. Twenty or thirty years ago, this abuse of mercury was carried to a much greater extent than it is at present. A calomel pill at night, and a black dose in the morning, were the panacea for all diseases in all kinds of constitutions—from the congested liver of the overgorged alderman, to the torpid liver of the weak and indolent female. Although the miserable consequences of this indiscriminate use of mercury were often too apparent to escape notice; yet such was its convenience, and such the force of habit, that the practice long maintained its ground. Nay, even yet, the abuse of mercury is not so entirely obsolete as to cease to be an object for animadversion.

The effects of mercury on different constitutions, and in different states of the same constitution, are remarkably various. Some individuals, both in a state of health and of disease, are almost insensible to the action of mercury; while other individuals, under all circumstances, are affected by the minutest doses. As a general rule, I believe it is admitted, that a state of health is more susceptible of the influence of mercury than a state of disease; particularly of inflammatory disease. Hence many individuals who would be instantly salivated by a few grains of calomel when in health, will be often found to bear almost any quantity of that drug when laboring under an acute inflammatory attack. These peculiar and important effects of mercury point at once to the following maxims regarding its use:

First, Mercury ought in no instance to be administered for those slight deviations from health which can be readily removed by safer expedients.

Secondly, Mercury ought to be cautiously administered to strangers ; and to those on whose constitution its effects have not yet been ascertained.

The practical value of those maxims may be thus illustrated :

First, one of the supposed effects of mercury is its stimulating operation on the liver ; and admitting this common opinion of its action to be well founded, let us briefly inquire into the consequences of perpetually subjecting the liver and the other assimilating organs to the stimulus of mercury.

The stimulating effects of mercury may be analogically illustrated by the stimulating effects of dram-drinking. As the stomach accustomed to ardent spirits will scarcely tolerate any weaker beverage ; so the liver, accustomed to the stimulus of mercury, will hardly respond to any other influence. Those, therefore, who in early life have on all trivial occasions resorted to the powerful stimulus of mercury, like early dram-drinkers, are usually obliged to persist in the baneful habit. The truth of this analogy will be scarcely questioned ; for the most superficial observer must have noticed, that patients who habitually take calomel are more than ordinarily subject to periodical congestions, or *biliary* attacks as they are termed ; and that such biliary attacks will rarely yield to any other remedy than calomel. Nor is the insensibility to gentler expedients, thus too often produced in the soundest constitutions by the use of mercury, its only fault ; the habitual use of this remedy is capable of exerting positive mischief on the assimilating functions and on the kidneys of some individuals ; as will be shown in subsequent parts of this volume. Moreover, those who are under the influence of mercury in a degree far short of salivation, are notoriously liable to take cold, rheumatism, &c., from slight exposure ; and various formidable and fatal diseases, as phthisis, &c., can be often distinctly traced to such exposure under the influence of mercury.

Many, I have no doubt, whose views have been limited to the *immediate* operation of mercury, will be disposed to think, that what is here said of its ulterior effects is exaggerated. If, however, they will take the pains to investigate the history of mercurialised patients ; and particularly the condition of their assimilating organs and kidneys ; they will soon find ample proof of the truth of what has been stated : at least I can truly say, that a

large proportion of the most inveterate dyspeptic and urinary diseases which I have seen, have been distinctly referable to the abuse of mercury. I am prepared for the objection, that many individuals begin the use of mercury early and continue it with the same evident advantage to extreme old age; and I meet this objection by the statement, that many individuals begin the free use of wine and of spirits at an early age, and continue to use them to extreme old age; but no one, forgetting the millions that have in the mean time fallen victims to the abuse of fermented liquors, will contend that such ought to become the rule; and the same remark is strictly applicable to the abuse of mercury.

In these observations on the subject of mercury, I must beg not to be misunderstood. When a real disease exists, for the cure of which mercury is appropriate; and when the constitution of the patient, or the nature of the concomitant disease, does not forbid its use, no one has a higher opinion of the good effects of this active remedy than myself, or employs it more freely. My object is to impress on the reader the important fact, that *when it has no real disease to combat, mercury is liable to give occasion to a disease*; and consequently to warn him against the indiscriminate use of this active remedy on trivial occasions, and in all diseases and constitutions.

The second maxim above mentioned, regarding the employment of mercury, is in fact included in the first; and has been separately spoken of solely on account of its importance. In a large proportion of chronic affections of the assimilating organs, inquiry should be made before administering mercury, whether the patient has been accustomed to the remedy, and what are its effects on the system. If the patient has been accustomed to mercury, recourse in general must be had to it again for accomplishing the simplest purposes. If, on the contrary, he be a stranger to the stimulus, it will be often found that he will recover just as well without. When mercury may be deemed necessary for patients labouring under chronic diseases, and who have not taken the remedy before, it will be prudent to begin with small doses, and to carefully watch the effects. Indeed in all instances it should be borne in mind, that in chronic disease more especially, the good effects of mercury are not in proportion to the largeness of the dose; but rather to

the length of time during which the salutary powers of the remedy can be made to bear on the system.

The preceding remarks on the use of mercury in chronic affections of the assimilating organs, are more especially applicable in cold and variable climates like our own; and in those derangements in which the assimilation of the Saccharine principle is particularly involved. They have been introduced here, therefore, once for all, as an appropriate introduction to the employment of mercury in Diabetes, the point we have in the next place to consider.

The effects of mercury in Diabetes have been variously represented; and indeed they are so different in different instances, that mercury has even been proposed as a remedy in this affection. Sometimes this drug, however largely given or applied, neither produces salivation, nor increases the quantity of the urine; but even under these circumstances, which are rare, and the most favourable that can occur, I am compelled to state that I have never seen the specific operation of mercury beneficial in diabetic disease; but, on the contrary, almost invariably mischievous. This mischief has been displayed in various ways connected with the urinary secretion; that is, the specific gravity of the urine has been increased; or the secretion has become serous, or otherwise deteriorated. Moreover, when the effects of the mercury have ceased, the patient has usually become worse than before; and the disease, after assuming its most unsavourable form, has rapidly advanced to its fatal termination. In other instances, in which the diabetic affection has been partially subdued by appropriate treatment, I have seen a few grains of blue pill inadvertently given, in the short space of a day or two, double and even triple the quantity of urine; and thus the benefit, to obtain which perhaps months had been required, has been lost as it were in a moment; and the patient has been reduced to a worse state than he was in at first.

If the opinions deduced from the observations stated be admitted to be well founded, perhaps the use of mercury in Diabetes may be limited to the following three cases, or complications: First, General inflammatory or phlogistic fever; Secondly, Acute or chronic inflammation of the liver; and Thirdly, The temporary congestion apt to occur in those individuals, who have been long

accustomed to the stimulus of mercury. On each of these points we shall make a few remarks.

First, according to my observations, acute phlogistic fever and inflammation are of rare occurrence in diabetic individuals. Something of the kind, indeed, occasionally arises in plethoric individuals, in the earlier stages of the affection, from exposure to cold ; but the acute stage, though perhaps at the outset strongly marked, is usually of short duration, and rapidly passes into the adynamic form, with a disposition in the inflamed parts to become gangrenous. The acute stage of such attacks therefore is so transient, that it usually disappears before medical advice can be obtained ; otherwise, if properly met at the very beginning by free abstraction of blood, and the judicious application of calomel and opium, there is a chance that the progress of such attacks may be arrested. But if the peculiar adynamic state become once established, I fear nothing can be done ; at least, no mode of treatment I have hitherto seen tried has succeeded ; and the patient, in every instance, has died in a few days with symptoms more or less resembling those of typhus fever.

Secondly, affections of the liver, as we have already stated, are not unfrequent complications in Diabetes. I have never, indeed, seen acute hepatitis, in the sense I understand the term, in a diabetic patient ; but I have seen chronic inflammation with congestive enlargement and jaundice, and too frequently organic disease of the liver, accompany this disease ; and it is in the management of such cases that mercury in Diabetes is most liable to be abused. In the treatment of complications of this nature, the rule to be attended to, is to do everything in the first place that can be done by the aid of other expedients ; so as to leave that only to be done by mercury, which mercury alone will accomplish. General and local activity, therefore, should be reduced as speedily and effectually as possible, by the abstraction of blood, by blistering, and by other well-known expedients ; and when these means have effected all they are capable of doing, the aid of mercury may be resorted to. The peculiar circumstances of the case must, in some degree, determine the mode of employing this active remedy ; but in general as little as possible should be given internally, and the form of inunction, plasters, &c., should be preferred. When given internally, mercury should, for the most

part, be conjoined with opium ; and of the different preparations of the drug, perhaps calomel so associated constitutes, on the whole, the least objectionable mode of administration. Under this plan of treatment, I have known several cases in which the hepatic affection has been apparently subdued, with a temporary aggravation only of the diabetic symptoms ; and the patient has lived for years afterwards, without any return of the affection. On the other hand, I have seen the diabetic symptoms neglected, nay, even laughed at, by the medical attendant, and mercury rudely administered in the ordinary modes ; with some apparent relief certainly of the hepatic symptoms in a few instances ; but always with the ultimate aggravation of the Diabetes, which has speedily proved fatal. When hepatic disorder is accompanied by organic disease of the liver, the use of mercury requires caution in every case ; but particularly when Diabetes is likewise present. In such unfortunate complications, mercury, without a chance of doing good, can be only expected to accelerate the fatal event.

Thirdly, the occasional use of alterative doses of mercury, either combined with sedatives or with mild purgatives, or with both, according to circumstances, is beneficial in some constitutions ; and particularly in those who from early life have been accustomed to the stimulus of mercury. With respect to the dose, as well as the frequency and mode of exhibiting the remedy in such cases ; these will depend on the circumstances and constitution of the patient, and must be left to the judgment of the practitioner. In diabetes accompanied by hepatic derangements, a protracted course of the taraxacum often exerts a favourable influence.

Such is an outline of the general plan of treatment recommended in Diabetes. To lay down a specific plan that shall be adopted in all cases is impossible ; for the disease varies so much according to the constitution of the patient, and other circumstances, that no one remedy, or set of remedies, will in all cases be appropriate. The expedients stated, therefore, must be so applied and associated as to meet most effectually the circumstances of the case ; and when so applied, they will probably accomplish all that can be reasonably hoped for in this disease. Under such a plan of treatment, I have *now* seen many cases in which the saccharine quality of the urine has, for the time, entirely disappeared ; and a very great number of cases, in which the

symptoms have been so far subdued as to give little trouble to the patient. Indeed I have seen no case of a favourable nature which has not been more or less benefited; provided the patient has steadily adhered to the plan of regimen, &c., prescribed for him, and considered himself, what every diabetic individual ought, through life, to consider himself, an *invalid*; that is to say, *as a person whose ordinary state of health is such as to require in all respects more than usual care and attention.*

I shall close these remarks with a short account of the most common forms of Diabetic Diuresis as it occurs in very young children.

In young children, as in adults, diuresis is a symptom of very different forms of disease; in all these diseases the urine, as well as being excessive in quantity, is more or less unnatural. Thus in infantile diuresis the urine frequently contains *albuminous matters*; in other instances an *excess or deficiency of urea* exists; while in a few cases, *saccharine matters*, more or less perfectly developed, are met with; either alone, or in conjunction with the above, or with other unnatural ingredients. Of the most remarkable of these forms of disease, the following is a brief sketch; which, from their close analogy to each other, as well as to avoid repetition, we give here, once for all.

All the forms of diuresis as they usually appear in young children commence soon after the period of weaning. From having been to that time healthy, the child begins to get dull and inactive, and to daily lose flesh. The skin feels harsh and dry, and is hotter than natural. The bowels also become irregular; the motions assume an unnatural, often greenish appearance; and the abdomen becomes prominent, so as to lead to the suspicion of mesenteric disease. The pulse is quick, and denotes great irritability. At this period, the urine is generally scanty and high-coloured; becomes turbid immediately on cooling; and lets fall a pale clay-coloured deposit of lithate of ammonia, sometimes intermixed with the oxalate of lime, or phosphates. As the disease proceeds, the quantity of urine rapidly increases; and the thirst being commen-

surate, large quantities of fluid are consequently taken ; so that an infant under twelve months old will be often found to pass from two to four or five pints of urine in twenty-four hours. The urine in this, and indeed in all the subsequent stages of the affection, is commonly transparent and of a pale yellow or greenish tint. Its specific gravity varies from 1·010 to 1·025, and on examination it will be found to contain a great excess of urea ; and occasionally traces of albumen and sugar.

The progress of this disease depends much on circumstances. If it be neglected or mal-treated, it most usually terminates in organic lesion of the kidneys, accompanied by deficiency of urea, and the presence of albuminous matter in the urine ; or occasionally it terminates in Diabetes. We shall briefly sketch the state of the symptoms and of the urine, as they appear in these two ulterior forms of infantile diuresis.

Diuresis with deficiency of urea, &c., in young children, is usually accompanied by all the symptoms above mentioned, but in a more strongly-marked degree. The thirst and dryness of the skin are more troublesome ; the bowels more deranged ; the debility and emaciation more extreme ; the quantity of the urine also is greater and its qualities of a worse character ; that is, its specific gravity is depressed far below 1·010, even to 1·005 or less ; and it often contains albuminous matter. This state of things continues for an indefinite period according to circumstances ; when the little patient is generally cut off rather suddenly ; either by coma, preceded and accompanied by suppression of urine ; or by convulsions. In infantile Diabetes, many of the symptoms are very similar to those just related as occurring when the kidneys have become involved, and there is a deficiency of urea, &c., in the urine ; but besides great thirst, there is generally a ravenous appetite, or at least a great craving for food. The urine also is of a pale straw or greenish colour ; and is sometimes opalescent or milky. Its specific gravity is higher than in the previous affection, and frequently falls within the diabetic range ; that is, its specific gravity is generally above 1·030 ; though, according to my observations, the urine of diabetic young children seldom reaches the high point of the diabetic urine of adults. Infantile diabetic urine often contains more or less of a chylous albumen ; which acting as a ferment causes it to undergo rapid

changes, either by the lactic or the vinous fermentation ; or by both in quick succession. Hence such urine generally soon begins to emit the odour of sour milk ; especially in warm weather.

These forms of disease which, as already stated, may perhaps be considered only as different modifications or degrees of the same affection, most frequently occur in the children of strumous individuals, who are at the same time dyspeptic or gouty. Hence they are most frequently seen in large towns, among the children of profligate artizans, &c., where want of air, improper nourishment, and injudicious treatment, cause these affections to assume their most unmanageable forms. They are occasionally met with, however, among the children of delicate and unhealthy individuals in every rank of society.

Infantile diuresis in all its forms must be considered as of rather a formidable character. For even if the disease be arrested, by judicious treatment in its earlier stages ; the individual is apt to remain delicate, and not unfrequently dies in early life of phthisis, or of some other organic lesion. When infantile diuresis has fairly assumed its worst form, there is little hope of a protracted existence ; and the patient is usually cut off in one or other of the modes above stated.

Treatment.—The general principles of treatment are much the same in all the varieties of the affection ; attention of course being paid to the degree and nature of the more urgent symptoms. In the first place, the removal to a purer air, or to the sea, is indispensable ; indeed, a frequent change of air alone often exerts more beneficial effects than almost any other remedy. In changing the air, however, regard must be had to its temperature and degree of dryness. A moderately bracing and dry air should be preferred ; and extreme degrees of temperature, particularly of cold ; as well as extreme degrees of moisture, which always increases the flow of urine, should be carefully shunned. In connexion with the change of air, the tepid or warm sea bath, with friction over the skin, &c., will be occasionally found beneficial.

Another point of quite as much importance as change of air, is attention to diet ; which should consist chiefly of animal and farinaceous matters. Of animal matters, those involving the albuminous, rather than the gelatinous, principle should be preferred ; or at least albuminous matter should form a part of the diet; though

concentrated animal decoctions, consisting chiefly of gelatinous matters, may be taken occasionally, either alone or mixed with milk. Pure milk, or milk diluted with water, may be also taken freely; and when cows' milk disagrees, asses' milk should be substituted. Of farinaceous matters, those which have not undergone the fermentative change, as biscuit powder, or torrified flour, should be preferred to common bread; and particularly to the highly-fermented rusk so often injudiciously recommended for children. The quantity of fluids taken must be strictly defined and gradually diminished; and for the purpose of carrying out this intention the more easily, as well as of mitigating the excessive irritability commonly present; small doses of the *pulv. ipecac. comp.* are sometimes useful. In young children, however, the sudden withdrawal of fluids, as well as the use of opium, require caution, from the tendency of these expedients to cause a suppression of urine; which is almost certain to terminate in coma and death.

The state of the bowels must be most carefully attended to; and while calomel purges are highly improper, some gentle alternative, as the *hydrargy. cum creta*, combined with rhubarb and magnesia, or with the carbonate of soda, calumba, &c., may be given with advantage. Other tonics also suitable to the age and circumstances of the patient may be resorted to. Dr. Venables has strongly recommended the use of the blue phosphate of iron; and this, or the tartrate, citrate, ammoniated, tincture or carbonate of iron, combined with a little calumba or magnesia, is often highly useful.

SECTION b.—*Of the Oxalic Acid Diathesis.*

In the present class of diseases, the oxalic acid is supposed to constitute the predominating unnatural ingredient in the urine. Those dyspeptic derangements, in which the oxalate of lime occasionally appears in small proportion among the urinary sediments, will be considered elsewhere.

In treating of the subject of oxalic acid diseases, we shall first give an outline of the phenomena usually presented by the urine during the presence of oxalic acid in the system, as *shown more particularly by the formation of oxalate of lime calculi*; and afterwards point out such variations and modifications in the phenomena as arise from differences in the constitution of the patient; or from differences in the exciting causes, &c. The Diagnosis Prognosis, and Treatment, will then be considered in the usual order.

When the formation of oxalic acid is the predominating vice of the system, the urine is generally transparent, and remarkably free from sediments; of a pale citron yellow, or greenish, hue; and of moderate specific gravity; that is, the specific gravity usually oscillates about 1·020 as a mean point, but is often less than this—a circumstance chiefly referable to variations in the quantity of the urine secreted; which is frequently above the healthy standard. Urine containing oxalic acid seldom contains sugar; yet I have seen a few instances in which the two unnatural ingredients have not only co-existed, but appeared to pass into each other. That is, sugar has gradually given place to the oxalate of lime, and *v. v.* the oxalate of lime to sugar.

The properties of the urine here described, when well marked, are sufficiently definite to lead those who are conversant with the phenomena presented by the urine in *glass* vessels, to *suspect* the presence of the Oxalic Acid Diathesis; but, they are *not* sufficiently definite to enable the most experienced eye, much less the inexperienced, to decide at once upon the point. For the urine of healthy individuals may, from accidental causes, such as peculiar articles of diet, &c., occasionally assume appearances so resembling those stated, as not to be distinguishable from them. The judgment,

therefore, must in all instances be formed from the *general* tenor of the phenomena ; and from the concomitant symptoms to be presently detailed ; and these taken together, for the most part, leave little doubt on the subject ; even though an oxalate of lime calculus may not have been known to have passed from the kidney.*

The symptoms usually connected with the Oxalic Acid Diathesis, belong to the irritable or nervous class, rather than to the congestive or inflammatory. The stomach is apt to be oppressed with flatulence, especially when empty ; and the gaseous matters extricated generally contain an unusual proportion of azote. This state of flatulence is very often associated with irregular action of the heart, and particularly with intermission of the pulse. The *reducing* function of the stomach is much less active than in Diabetes ; but sometimes there is great craving for food, which, as far as the stomach is concerned, is apparently disposed of readily ; and without producing that acidity so frequently caused by solid matters, when the reducing function of the stomach is weak. There is occasionally pain on pressure in the region of the stomach ; and this tenderness of the organ is sometimes accompanied by a sense of heat, and in a few instances, by severe gastrodynia ; but these symptoms do not appear to be so frequent as in some other forms of dyspepsia. Those who labour under this form of dyspepsia have generally less desire for solid animal food than for vegetable matters ; and there is not unfrequently a strong propensity for sweet things, and particularly for

* The recent improvements in the microscope much facilitate the detection of oxalate of lime and other matters in the urine. I was well acquainted with the late Dr. Goring, the early and great improver of the microscope among us, who first drew my attention to this instrument nearly thirty years ago. I possessed one of the best of the old construction that could be procured, and was in the habit of constantly applying it to urinary sediments and other matters long before it was generally employed for such purposes in this country. Hence almost all the microscopic phenomena of urinary sediments now so familiar, were well known to me. The instrument I employed, however, was far inferior to those now in use, and hence, though it was capable of showing the more prominent phenomena, it very imperfectly or altogether failed to show many phenomena of importance. Thus the oxalate of lime crystals when large, were occasionally seen in the urine, while in the greater number of cases they could not be detected.

sugar ; which is apt to be indulged to great excess. In some the tongue is loaded with a white fur, particularly in the morning ; in many this organ presents no remarkable appearance ; and in a few it is preternaturally clean and red, especially round the edges.

At a certain period after eating, greater or less according to circumstances, there is commonly a sense of unensiness arising from flatulent distention of the duodenum, which by degrees is propagated to the region of the cæcum ; and during the time this portion of the assimilating processes is going on, the patient commonly feels most uncomfortable. The bowels, like the secretion of the bile by which they are principally influenced, are capricious and irregular ; the *quantity* of the bile being either deficient, or in excess ; and the bowels responding accordingly. The *qualities* also of the bile are subject to great variety, being sometimes of a greenish hue ; at other times of an orange red, or chocolate brown tint ; at other times almost black. Under these circumstances the faeces are imperfectly formed ; or are loaded with mucus ; or are preternaturally acid. Moreover, there is occasionally a tendency to periodical discharges of dark-coloured blood, both from the rectum and bladder ; particularly in swarthy individuals.

The constitutional symptoms vary exceedingly in this Diathesis ; according as their degree and character are influenced by the peculiar temperament of the patient. In individuals of the sanguine temperament, for instance, particularly when subject to cutaneous diseases, the constitutional symptoms are usually manifested in the form of extreme irritability of temper or manner ; more especially if the cutaneous affection has, from any cause, been suddenly repelled. In individuals of the melancholic temperament, on the contrary, the constitutional symptoms usually partake of the desponding and hypochondriacal character. External circumstances also of various kinds have often the effect of determining the symptoms into favourable or unfavourable channels ; and thus of mitigating or of aggravating them, as the case may be.

When the obvious presence of a small calculus in the kidney or bladder leaves the nature of the case no longer doubtful, and occasions for the first time the appearance of blood in the urine ; the occurrence, whether accompanied by pain or not, is apt to forcibly attract the patient's attention. He has now a definite

object to complain of, and, forgetting everything else, becomes alive to every little symptom connected with the urinary organs, which otherwise would scarcely have attracted his notice. At length he suffers a nephritic attack; gets rid of most of his troubles with his calculus; and, after a greater or less period, recovers, perhaps for years, his former state of health.

The following are some of the more remarkable varieties presented by the symptoms accompanying the Oxalic Acid Diathesis, as they occur in different individuals, under different circumstances and complications.

The peculiar symptoms attending the oxalate of lime diathesis, as already stated, vary exceedingly, both in degree and in kind. Sometimes they are so slight as to pass unnoticed by the patient; or at most are considered as dyspeptic derangements of no importance. At other times, the bodily suffering is considerable; while the mental excitement verges on insanity. Flatulence and irregular action of the heart constitute the most frequent symptoms present; and although these symptoms can by no means be considered as characteristic of the Diathesis, when the other symptoms exist at the same time, the combination serves to confirm our diagnosis. Hæmorrhage from the kidneys is, perhaps, more frequently produced by an oxalate of lime, than by any other form of concretion. This may depend in part on the peculiar form of the calculus; but the chief cause probably lies in the nature of the Diathesis. As a point in illustration, I may remind the reader of the fact before mentioned, that more cases of hæmorrhage from the urinary organs occurred to me during the season following the prevalence of cholera in this country, than I had ever before seen in the same time. This unusual tendency to hæmorrhage at first misled me in my prognosis; for before this period I had almost invariably noticed, that the appearance of blood in the urine indicated either the presence of stone, or of malignant disease in some part of the urinary organs; whereas, in a great many of the instances alluded to, the hæmorrhage ceased after a time, without being apparently attended by either of these circumstances. Within the last few years, the phenomena of hæmorrhage from the urinary organs have resumed much of their former characters.

When a great deal of saccharine matter is consumed as food,

by dyspeptic individuals, more especially in cold climates, the urine often contains sugar as well as oxalic acid; and when sugar, and particularly oxalic acid, are thus freely taken, the urinary sediments almost always contain more or less of the oxalate of lime. The oxalic acid diathesis is also sometimes associated with serous urino, especially in young subjects; in which case the urine is generally opalescent and of a greenish tint.

Finally, it should be borne in mind, that of the hundreds of individuals in whom this Diathesis prevails, a few only suffer from calculus. The existence of a renal calculus of oxalate of lime seems to be generally an accidental circumstance; and, in almost every instance, the formation of such concretion depends either on the presence of some foreign body, or some local inflammatory action of the kidney. And, provided these concurring causes are absent, in a very few cases only does the mere presence, even in excess, of the oxalate of lime, seem to give occasion to the formation of a calculus.*

Causes.—The formation, or at least the existence of oxalic acid, is not peculiar to the human subject, but occurs in some rare instances in the inferior animals. Thus calculi composed of this substance have been found in the dog and rat; and I believe in other animals.†

A *predisposition* to the Oxalic Acid Diathesis, as to Diabetes, appears in some cases to be inherited, but not, I think, so frequently; in other words, the predisposing causes have less influence in the production of the Diathesis, than the exciting; though, as in Diabetes, both kinds of cause usually co-operate to produce the most decided instances.

A syphilitic taint, whether remote and inherited, or acquired, seems occasionally to give a predisposition to this Diathesis. I have seen many individuals so circumstanced, labour under the worst forms of syphilitic dyspepsia, and the most inveterate cutaneous disease, in connexion with the Oxalic Acid Diathesis. Other predisposing causes, like the predisposing causes of Diabetes, may be classed under the heads of temperament, sex, and

* The subject of renal calculi will be fully considered in a subsequent part of this volume.

† Fourcroy and Vauquelin, Ann. de Mus. de Hist. Nat. iv. 338.

The Oxalic Acid Diathesis occurs in all temperaments ; but individuals of the sanguine temperament on the one hand, and of the melancholic on the other, seem to be most liable to it. In subjects of the first class, it is generally associated with light or reddish hair; a dry and irritable skin ; and with a tendency to an impetiginous, or some allied cutaneous affection, which is not unfrequently inherited. In subjects of the second class, in whom the hair and eyes are usually dark, there is commonly less tendency to cutaneous irritation and disease ; but a much greater tendency to affections of the cellular and parenchymatous tissues. In further illustration of this point I may also observe, that the most inveterate tendencies to this Diathesis which have fallen under my observation, have occurred in individuals of a mixed temperament. Thus I know a gentleman who inherits, in the highest degree, the irritable skin of the sanguine temperament, with the dark and swarthy aspect of the melancholic, and in whom all the symptoms of this Diathesis exist in a strongly marked form.* When the Diathesis is strongly marked, the skin in all temperaments is apt to assume an unnatural appearance difficult to describe ; but the *colour* of which may be said to vary from dull greenish yellow in the sanguine, to dark olive or livid in the melancholic temperament. Both classes of individuals also are often liable to boils, which in old and enfeebled habits are apt to degenerate into carbuncles.

Like Diabetes, this Diathesis, according to my observations, is more rare in women than in men, and when it does occur in women, it is often associated with a rheumatic gouty tendency and uterine disorder. Oxalate of lime is occasionally found in the urine at all intermediate periods between infancy and old age ; though the periods of life most subject to it seem to be between two and twenty-four, and forty and sixty-five years of age.

Among *exciting* causes of the Oxalic Acid Diathesis, one of the most striking I am acquainted with, as before observed, is a residence in a damp and malarious district. In such a district the predisposed seldom escape ; and even those who are not predisposed, are apt, after a time, to become more or less affected ; particularly if their diet consists of a large portion of saccharine

* It may be worth mentioning that this gentleman's wife is as dark as himself ; yet three of his children, out of six, have light red hair.

or of unwholesome farinaceous matters. The Oxalic Acid Diathesis seems to differ remarkably from Diabetes, in not being liable to be excited by mere exposure to cold, nor by an attack of rheumatism, or of gout. I have never been able distinctly to trace an oxalate of lime calculus to mere exposure to cold ; nor have I seen it follow acute rheumatism. This form of concretion, however, is often accompanied by chronic rheumatism ; and occasionally *follows* an attack of gout. Diet, under all circumstances, but particularly in strongly predisposed habits, has perhaps more influence in exciting this Diathesis than any other cause. I have seen repeated cases in which the too free use, or rather abuse, of sugar has given occasion to the oxalic acid form of dyspepsia ; and sooner or later, under favourable circumstances, to the formation of an oxalate of lime calculus. I have also seen, as before noticed, well-marked instances in which an oxalate of lime nephritic attack has followed the free use of rhubarb, (in the shape of tarts, &c.,) particularly when the patient has been in the habit, at the same time, of drinking *hard* water. Among exciting causes in certain habits, may be likewise mentioned excessive venereal indulgences,* or loss of blood ; also the depressing passions, and more especially grief. I could give a long list of instances apparently referable to such causes alone. The prevalence of this form of dyspepsia among the dissipated and ill-fed inhabitants of large towns, has been already noticed. The influence of certain epidemic diseases, as cholera, for example, has also been stated. With respect to diseases of the skin and cellular tissue, as exciting or rather concomitant circumstances of the Oxalic Acid Diathesis, there is this remarkable difference ; that in diabetic affections cutaneous diseases are rather uncommon ; whereas these affections are of frequent occurrence in the Oxalic Acid Diathesis. As an illustration of this position, I may remark, that I have seen the cutaneous disease gradually disappear, as the Oxalic Acid Diathe-

* A gentleman beyond the middle age, who had long been a remarkable sufferer from lithic acid calculi, married a lady considerably his junior. From this time the lithic acid left him ; but he soon began to suffer from oxalate of lime concretions, of which he had repeated severe attacks. The change could scarcely be referred to any other cause, as his habits, residence, &c., remained in all respects the same as they had previously been for many years. Spermatorrhœa often adds to the debility accompanying the oxalate of lime diathesis.

sis has passed (as it sometimes does) into Diabetes. I have also seen an oxalate of lime concretion, as well as Diabetes, in individuals whose mothers had died of malignant disease of the stomach.

The presence of oxalic acid in the system, as far as the primary assimilating processes are concerned, arises from one of two causes, which, for want of a better name we term *proximate* causes ; viz., the non-assimilation of oxalic acid taken as food ; and the mal-assimilation of saccharine aliments, and in extreme cases, perhaps, of albuminous and oleaginous aliments. The first of these causes may exist without the second, and may even give occasion to the formation of a nephritic oxalato of lime attack, without producing, in a marked degree at least, the constitutional symptoms usually present in this Diathesis ; of which I have seen instances. It is probable that the first cause operates principally in those in whom the *converting* function of the stomach is *deficient in power* ; and in whom, at the same time, there is a predisposition to the Oxalic Acid Diathesis ; for there is every reason to believe, that the perfectly healthy stomach can convert small quantities of the oxalic acid when mixed with the articles of food. The second cause consists in something more than mere weakness ; there is in this case a *positive derangement of the converting function* of the stomach. These two conditions, however, of the converting functions of the stomach, may be supposed to be so nearly allied, as not only in some instances to co-exist, but to pass into each other. With respect to the formation of oxalic acid during the secondary assimilating processes, we have nothing to add to what has been already stated in the general remarks pre-fixed to this chapter.

The *diagnostic* phenomena of the Oxalic Acid Diathesis, are well marked as a group, though they require considerable experience and attention to discriminate them.* Moreover, from the comparative rarity of the affection in certain localities and seasons, the necessary opportunities for studying the affection cannot be always commanded. Of such importance, however, is the knowledge of the affection in other localities and seasons, that

* The inquiry, however, as already stated, is much facilitated by the use of the improved modern microscope.

no pains should be spared to study the phenomena; not only for their own sake, but for the sake of the light they will hereafter throw on some of the most painful scourges of humanity.

The *prognosis* in the Oxalic Acid Diathesis is favourable or unfavourable, according to the degree in which it exists; and according to a variety of other circumstances. In slighter cases there is no affection more manageable, if properly treated. In severe cases, particularly if complicated with organic disease, there is no affection more formidable, nor more apt to take on a malignant and intractable character.

Post-mortem examinations, as in Diabetes, have thrown very little light on the cause or nature of the Oxalic Acid Diathesis. In the few opportunities I have had of examining the bodies of those who have died with this Diathesis, the immediate cause of death has been either organic disease of the kidneys, (generally combined with oxalate of lime calculus,) or some malignant disease of other organs. As in Diabetes, there has been great tendency to acidity in the system; and the veins of the abdominal system have been unusually congested with dark-coloured blood.

Treatment.—The plan of *diet*, &c., applicable to the Oxalic Acid Diathesis, coincides nearly with that applicable to Diabetes. We refer the reader, therefore, for details to the preceding section; and shall content ourselves here with briefly stating the leading facts, and pointing out the most remarkable differences applicable to the Oxalic Acid Diathesis. In the first place, the patient should carefully abstain from all saccharine articles of food, and particularly from *sugar*; and his diet should principally consist of animal, and of the stronger farinaceous matters. As, however, the *reducing* function of the stomach is often considerably impaired in this Diathesis, solid and indigestible matters should be sparingly taken, or shunned altogether. Hence the French cookery, by which animal and other matters are reduced to a semifluid or pultaceous mass, often agrees better than the crude and solid chops or steaks of this country. There are many exceptions, however, to this observation; and if the reducing function be not very much impaired, it is proper in all instances to take a certain portion of food of an easily reducible character; the best method of restoring the reducing, as well as all other weakened functions, being to moderately exercise them. When

the stomach, as is often the case, cannot reduce oleaginous aliment, butter should be avoided ; otherwise there is no objection to its use. As *drinks*, fermented liquors should in general be abstained from as much as possible ; in this respect, however, everything will depend on the previous habits of the patient. Sometimes a little good porter agrees well, and may be taken. When porter is deemed objectionable, diluted brandy is preferable to most wines ; particularly those wines containing unfermented sugar. Sound and dry sherry, or even hock and claret, occasionally agree, and may be cautiously taken in some cases ; particularly in warm weather, when the skin is active. In cold damp weather, all such fluids are better avoided. The quality of the water employed is of the utmost importance. Those whose assimilating organs form oxalic acid, and who at the same time drink water containing lime in solution, are exceedingly liable to get an oxalate of lime calculi. The purest water, therefore, that can be obtained, even distilled water, should in all instances be preferred.

The principles to be kept in view in the medical treatment of the Oxalic Acid Diathesis, like the diet, &c., are not very dissimilar to those before laid down in Diabetes. In general, the fixed alkalis are seldom beneficial, particularly in large doses ; in which form they often do absolute mischief. The volatile alkali, combined with camphor and sedatives, in cases of great irritability, is sometimes useful. The mineral acids, either alone or combined with tonics, as the sulphate of iron or of quinine, are usually grateful to the stomach, and may be taken with advantage ; indeed, generally speaking, I have seen more benefit derived from this class of remedies than from any other. The effects of the mineral acids must be watched ; and when they begin to produce a deposition of the lithate of ammonia or of lithic acid, their use must be suspended. Indeed, in all instances, the mineral acids require to be left off after a time ; as, when too long persisted in, they not only cease to do good, but in most instances do harm. In cases of this Diathesis, where the patient lives at a distance in the country, I commonly recommend the use of the nitro-muriatic acid in distilled water, to be taken an hour before breakfast and before dinner, and persisted in till the lithate of ammonia, or the lithic acid, begins to appear in the

urine ; or for a month ; and by adopting such a course of acids three or four times in the year, and by a carefully regulated diet, I have seen the Diathesis gradually subdued, and at length removed altogether. In the intervals between the use of the nitro-muriatic acid, other tonics, as the sulphate of quinine or zinc, the trisnitrate of bismuth, the oxide of silver, &c., may be resorted to if necessary, and are sometimes beneficial.

As a means of relieving the distressing flatulence and irregular action of the heart, so generally present in this affection, the hydro-cyanic acid, either alone or conjoined with digitalis, is often useful.

Nearly the same remarks apply to the use of mercury in this Diathesis as in Diabetes. There can be no objection to the occasional use of this remedy as an alterative or purgative, in those individuals who have been accustomed to the stimulus of mercury ; or in whom the hepatic system is congested ; but the specific effects of this remedy are very seldom beneficial in this Diathesis, and in many cases do irreparable mischief.

Of the Transition of the Oxalate of Lime to the Phosphatic Diathesis.

It will be shown hereafter that a deposition of the phosphates in the urine is much more frequently an *induced* than an original disease : that is, the phosphatic diathesis is generally the consequence of some local disease or irritation in the urinary organs, and thus becomes as it were *the point towards which all the other diatheses converge*. In treating therefore of the different diatheses, it may not be uninteresting to make a few remarks on the phenomena presented by the urine during its transition from each diathesis to the phosphatic diathesis.

During the transition from the oxalate of lime to the phosphatic diathesis, it appears from the dissection of calculi, as well as from the phenomena presented by the urine, that one of the first changes usually apparent, is the secretion of an excess of (carbonate) of

lime; and that as the quantity of lime becomes greater, the proportion of the oxalic acid is decreased, while that of the phosphoric acid is increased, until at length phosphate of lime in nearly a pure state is deposited. The urine during these changes also frequently deposits the triple phosphate; but, according to my remarks, the deposition of this salt is much less abundant than during the transition from the lithic to the phosphatic diathesis, to be hereafter noticed. As the changes proceed, the urine assumes all the properties of phosphatic urine; though even to the last, in adults, the phosphate of lime occasionally predominates over the triple phosphate. In children, the oxalate of lime, during its transition to the phosphates, is often accompanied by a portion of pale clay-coloured, or nearly white, lithate of ammonia; as well as by the triple phosphate of magnesia and ammonia.

The constitutional symptoms resemble those present when the oxalic acid diathesis prevails; but are almost invariably marked by local as well as by general irritation; that is, there is usually more or less of pain and uneasiness about the loins, and very frequently in the bladder; even when there is no calculus in that organ.

The *treatment* will vary with the symptoms, and cannot be precisely stated. If the principles, however, which we have attempted to establish be attended to, there will be little difficulty in adjusting the treatment to the different symptoms as they may arise. The leading principle to be kept in view in all such cases is, that the affection is of an *irritable* rather than of an *inflammatory* character.

SECTION c. *Of Lactic Acid, &c.*

A detailed consideration of the derangements to be spoken of in this section, scarcely falls within my present design. My chief object in noticing them, has been to point out their relation and analogy to the subjects of the volume in general, and thus, so far, of completing the outline of my plan. At some future time I may be induced to enter more at length into the matters discussed in the present section; perhaps in a separate volume. In the mean time, I am not without a hope that the hints now thrown out may set other observers to work, not only in this country, but in tropical climates; where all the prominent features of these derangements are usually much more boldly delineated.

As Lactic Acid, and the nearly related acetic acid, are alike developed from the saccharine and the Albuminous (or at least from the gelatinous form of the albuminous) principles; the consideration of the phenomena attending the development of these acids forms an appropriate link between the saccharine and albuminous derangements. Under the same head also, for the sake of convenience, we shall consider the subject of the muriatic and other acid principles usually developed in conjunction with the lactic acid during the assimilating processes.

The reader will bear in mind that we divide the assimilating processes into primary and secondary. Now the undue development or presence of the Lactic and other acids in these two divisions of the assimilating processes, gives occasion to two distinct classes of diseases; requiring a separate consideration. *

Of the development or presence of the Lactic Acid, &c., during the primary assimilating processes.—It will facilitate our inquiry into this portion of our subject, if we still further subdivide it into two parts, viz., the development or presence of the Lactic acid, &c., in the stomach; and the development or presence of the Lactic acid, &c., in the subsequent assimilating organs. We shall, accordingly, make a few remarks on the leading phenomena and diseases attending the undue development or presence of the Lactic

acid, &c., in these two portions of the assimilating organs ; and afterwards, in a general review, briefly notice the principles on which their treatment requires to be conducted.

The acids found in the *stomach* are derived from two sources — from the blood circulating in the vessels supplying the stomach, or from changes occurring in the matters secreted by these vessels ; and from the alimentary matters taken into that organ. The Lactic and muriatic acids are principally derived from the blood, and from the matters secreted or introduced into the stomach ; while the oxalic, butyric, acetic, carbonic, * and perhaps in some cases, the Lactic, acids, are developed from the food during its imperfect assimilation ; which imperfect assimilation is often a concomitant circumstance attending the abnormal development of the Lactic and muriatic acids. Hence in cases of severe dyspepsia, accompanied by great acidity, the acids present have possibly in all cases a double origin ; though their development from the blood, or from matters derived from the blood, rather than from the food, may be considered as constituting the index of the disease to be combated.

It will be shown in the Third PART of this volume, that the muriatic* and Lactic acids are always present in the stomach during the reducing process, and that their presence in some peculiar form of combination appears to be necessary to the accomplishment of that process ; it is therefore the *abnormal* presence of these acids in the stomach that we have now to consider ; and particularly the circumstances that determine the presence of the one acid rather than of the other ; for, in general, it may be observed, that though both acids may be in excess, one almost always predominates.

The circumstances that determine the predominance of one acid in the stomach rather than the other, cannot, perhaps, in the present state of our knowledge, be stated in all their details. The following observations, however, may afford a clue to the subject.

The predominance of the muriatic acid seems in general to denote a phlogistic or inflammatory state of the system ; while the

* It has been recently stated that muriatic acid does not exist in the stomach ; but that this statement is erroneous I have not the least doubt. The subject will be further noticed in the Third Book.

predominance of the Lactic acid marks rather a state of irritation. Such is the general law, and as a general law it is worth bearing in mind; but many exceptions and modifications exist; and the two classes of phenomena run so imperceptibly into each other, that it is impossible to draw the precise line between them. As illustrations of the subject, I may mention that in the dyspepsia of plethoric gouty individuals, I have generally found the muriatic acid predominant; so also in what are called *bilious attacks*, and gall-stones, as they occur in the same class of individuals, the predominant acid is usually the muriatic. In these and similar instances the stomach may be primarily in fault; but, in general, the stomach is affected by sympathy with some distant part. Thus, in *bilious* attacks, the hepatic system is supposed to be congested, so as to perform its functions imperfectly; or, as happens in some severe cases, the fault lies in one of the great nervous centres. So, in the same class of subjects, gouty or inflammatory action of the kidney, uterus, &c., is apt to be accompanied by a predominance of the muriatic acid. On the other hand, the same derangements and remote sympathies, when they occur in weak and delicate, or in *nervous* subjects, are very often attended by the presence of an excess of Lactic acid in the stomach. Moreover, in *all* dyspeptic subjects, hard and crude indigestible matters, when taken into the stomach, irritate that organ, and cause it to throw out a large quantity of the mixed acids, in which the Lactic acid almost always predominates; especially in the weak and delicate. An excess of acid, and particularly of Lactic acid, in the stomach, is sometimes accompanied by *gastrodynia*; that is, by rheumatic neuralgia, similar to that affecting other nerves of sensation. This happens most frequently in gouty and rheumatic subjects, in whom the exciting cause of the acid development has been some foreign indigestible substance.

With respect to the other acids formed in the stomach, these seem also to occur most generally in dyspeptic individuals in whom the muriatic and Lactic acids abound; and in whom, in consequence, the digestive processes are imperfectly performed. These acids appear to be chiefly derived from the food, and therefore are probably various in their nature. Among others, the carbonic acid is frequently developed not only from the food but apparently from the stomach itself; and, in its gaseous form, occasionally

proves a source of flatulent eructation. Another, and by far the most troublesome, source of flatulence, is azote. This, in nervous subjects, is occasionally developed from the stomach in enormous quantities in conjunction with the Laetic, and particularly with the oxalic acid, as formerly mentioned. At other times azote is probably derived from the food ; but from whatever source this gaseous principle be derived, it usually gives much annoyance ; for while the carbonic acid gas, on account of its stimulating qualitics, generally escapes from the stomach, the passive character of the azote, and the peculiar spasmodic constriction which usually accompanies its development, cause it to be retained, and thus, by distending the stomach, to add greatly to the miseries of the patient.

As we suppose the muriatic acid developed in the stomach to be derived from the muriate of soda existing in the blood ; it is probable that when the liver does its duty, the greater part of the free muriatic acid of the chlyme, when it enters the *duodenum*, is neutralised by the soda of the bilo. The case, however, appears to be very different with the Lactic acid, particularly when in great excess ; for as this excess of Lactic acid is usually generated, of course there can be no equivalent of alkali in the duodenum to neutralise it. The consequence is, that the free acid is either taken up with the chyle into the lacteals ; or descends into the intestines ; where, in conjunction with other acids there developed or separated, it produces various *secondary* symptoms, to be in the next place considered.

There is reason to believe that the perfectly natural condition of the whole intestinal canal, with the exception, perhaps, of the cœcum, is either neutral, or occasionally verges towards slight acidity on the one hand, and slight alkalinece on the other. When therefore the contents of the stomach have contained a quantity of acid too great to be neutralised in the duodenum, they of course enter the inferior portions of the alimentary canal in a more or less acid state, where they produce a variety of unpleasant symptoms. These symptoms are either local or remote ; and moreover differ remarkably in different individuals, and at different ages. In adults, while the acid ingesta remain in the duodenum, great discomfort and uneasiness of various kinds are experienced. Again, peculiar symptoms, among which are a sense of heat and

painful cholic, often attend the passage of acid matters down the small intestines ; while the lodgment of such acid matters in the cæcum occasionally appears to be connected with a train of symptoms to be described in the next paragraph. If the acid matters pass unneutralised from the cæcum, they usually give occasion to more or less of pain throughout the region of the colon, and sometimes excite diarrhœa. In young children, these and many other distressing symptoms, produced by acidity in the *prima via*, are still more strongly marked. Thus acid matters, in passing from the duodenum through the small intestines, often produce violent tortina, occasionally terminating in intus-susception ; while the presence and retention of acids in the cæcum and colon, not unfrequently give occasion to convulsions.

It is proper to remark, that some of the symptoms above alluded to as connected with the presence of acids in the *prima via*, may arise from the absorption of a portion of such acids into the system. Admitting this, however, to be the case, and that we cannot accurately distinguish between the symptoms produced by absorption of acid matters into the system, and by their contact with the irritable lining of the intestines ; the general fact, that the presence of acid matters in the intestinal canal occasions distressing symptoms of a secondary character, both local and remote, in certain individuals, cannot be doubted. We have no space for details ; but the following instance of distressing symptoms occasionally connected with morbid acidity of the contents of the cæcum, may serve to illustrate the point in question.

Excessive acidity of the cæcum is generally accompanied by a deficient secretion of bile ; and sometimes by a complete temporary suppression of the bilious discharge, apparently from spasmodic constriction of the common gall duct ; or, it may be, of the biliary ducts themselves. In this state of things, all individuals feel more or less of uneasiness ; but the point we wish to mention is, that certain individuals under these circumstances experience what is called nervous headache. This species of headache is frequently accompanied by nausea ; is confined to the forehead ; and when severe, produces complete intolerance of light and sounds, and a state of mind bordering on delirium. After a greater or less period the pain ceases ; sometimes quite suddenly ; and the remarkable circumstances to be mentioned are, that this sudden

termination is preceded by a peculiar sensation (sometimes accompanied by an audible clicking noise) in the region of the gall-ducts ; that immediately afterwards, a gurgling sensation is felt in the upper bowels, as if a fluid was passing through them ; and that in a few seconds, when this fluid, which we suppose to be bile, has reached the cæcum, the headache at once vanishes like a dream. One of the greatest martyrs to this species of headache I have ever seen, invariably experiences the train of symptoms above described ; and I have witnessed it in a greater or less degree in many instances ; indeed I have experienced it in my own person.

Of the Development of the Lactic Acid, &c., during the Secondary Assimilating Processes.—We have stated that the acids developed in the stomach and *prima vîe* appear to be absorbed into the system, and there to contribute towards producing various secondary effects, many of which are very distressing ; we have also stated that these secondary effects are with difficulty defined or separated from the effects produced by acidity in the *prima vîe* ; and we have now to state further, that these two classes of effects are with still greater difficulty distinguished from the effects produced by the acids developed during the secondary assimilating processes. For this reason, therefore, and for the additional reason that the three classes often co-exist ; we shall briefly speak of the whole in conjunction.

In dyspeptic individuals who pay no attention to diet, &c., and who suffer from acidity in the stomach and its consequences, the acid and unnatural matters developed in the *prima vîe* appear to be absorbed into the system ; where they probably tend to act as exciting causes of derangements in the secondary assimilating processes. The symptoms resulting from such combined derangements, like all symptoms connected with derangements of the assimilating organs, have more or less of a periodic character, and show themselves in occasional attacks of bilious congestion, gout, lithic acid gravel, catarrhal affections, ague, rheumatism, &c., according as exposure to cold, malarious influence, &c., co-operates with the original predispositions, and determines their nature.

It is remarkable that those who suffer least from derangements of the primary digestive processes, often experience the greatest

inconvenience from the derangements of the secondary class, or from their consequences. This is perhaps referable in a certain degree to the fact, that such individuals pay less attention to diet, than those whose condition of stomach obliges them to live more cautiously. As an illustration of this point, we may observe, that we frequently hear such individuals boast that nothing disagrees with their stomach ; and the consequence is, that they cannot be persuaded to abstain from the most improper things ; but partake of everything alike that comes in their way. In the prime of life, and in sound constitutions, this state of things goes on for periods varying according to circumstances, and particularly according as individuals are indolent or active. In almost all instances, however, sooner or later, the urine becomes loaded, the liver congested, and more or less of fever and derangement of the stomach and bowels,—in short, what is usually called a *bilious* attack, takes place. For this a calomel pill and a black dose are resorted to, and all being apparently righted, the individual resumes his former habits ; and after a time again undergoes the same round of changes. To this state of things we shall have occasion to recur : in the mean time we shall make a few remarks on a different series of events which now and then present themselves.

There are some individuals in whom, though the primary assimilating processes are imperfectly performed, and though they eat and drink immoderately, and of everything that comes in their way, suffer comparatively little inconvenience from their excesses ; nay, even seem to be all the better for them, if we believe their own account of the matter. In such individuals the bowels are usually lax, and enormous quantities of faeces are passed, consisting of matters taken as food, and which have never been assimilated at all ; while the portion that has been imperfectly assimilated and taken into the system readily passes off by the kidneys, skin, &c., without materially affecting the constitution. Subjects of this description, for the most part, are of a lax scrofulous habit, and require to be well supported, in order that enough of matters may be assimilated by their imperfect organs to carry on the vital processes. If such individuals be well fed, they often attain old age ; but they are liable to hypertrophies and morbid growths of various kinds ; and generally die of dropsy connected with exten-

sive organic disease. The children of such individuals, if they have any, which is frequently not the case, are usually sickly, and very often die in their infancy; and a third generation of such a race, unless counteracted by favourable intermarriages, rarely exists. Habits of this description are met with in various grades and states of combination; and individuals in whom such habit is associated with gout, gravel, or, in short, with any other inherited predisposition to disease, are commonly remarkable sufferers.

We now revert to that state of the system above alluded to, which, in healthy individuals who have lived fully and indolently, usually precedes what is called *a bilious attack*.

In those who suffer from indigestion, whether from excess or from disease, the acid and unassimilated matters appear, as we have stated, to accumulate in the system, and to be thrown off periodically by the bowels, or by other organs. Such attacks in the strong and healthy are usually displayed in the form of simple feverish excitement, with more than usual derangement of the stomach and bowels, and generally sickness and diarrhoea; but in the delicate, and in those predisposed to other diseases, the weak part, wherever it may be, is usually involved in the affection, and suffers in a greater or less degree. Of all other parts of the system, the mucous membranes seem to be most liable on such occasions to go wrong; and of all exciting causes, cold is perhaps the most common. Thus every one must have observed that when the system is so charged, he is liable, on the slightest exposure, to get cold; particularly if the lungs are in the least degree predisposed. Others, as above observed, in such a state of the system from a similar exposure, get an attack of rheumatism; others gout or erysipelas; others a nephritic attack; according as they are predisposed to these different diseases; and in all such instances the affection is of a mixed nature, and cannot be advantageously treated without reference to the original derangement of the assimilating processes; and sometimes, when this is removed, all the other symptoms disappear.* Nearly the same remarks apply to

* When a cold is caught particularly in old and dyspeptic individuals, one of the first symptoms often experienced is an immense discharge of glairy aqueous fluid from the salivary glands, and even from the stomach, (analogous to the *water-brash*,) and which is not acid. This discharge of fluid

malaria, and, indeed, to every other exciting cause of disease. Thus bilious individuals are very liable, on comparatively slight exposure to malarious influence, to get an attack of acute rheumatism, or of ague. For instance, I have known individuals thus predisposed, get an attack of rheumatism or ague, by simply passing through a malarious district, or residing for a few hours only in its neighbourhood ; while, in other states of the system, the same road has been frequented ; or the same residence occupied for months, and even for years, without any such accident. These facts are well known to every one who has paid attention to the subject ; and indeed are, we believe, generally admitted. They have been mentioned here from their connexion with the present subject ; as well as with the view of illustrating their pathology.

The condition of the system above described preceding what is called a bilious attack, being so obviously calculated to predispose the constitution to take on further diseased action, we are neither surprised to find that, in such a state of the system, the secondary assimilating processes going on in all parts of the economy, become more than usually deranged from slight exciting causes ; nor that those organs should *specifically* suffer, which

is often accompanied by indigestion and flatulence, and a sort of spasmodic constriction of the cardia, so that the gaseous matters are expelled with difficulty. The watery discharge has often a *cold* feel, and is frequently most copious in the night. The stomach also feels *cold*. These phenomena seem to occur most frequently in gouty and rheumatic subjects, and in some are constantly present, in a greater or less degree ; but in all, are increased by exposure to a damp and raw atmosphere. Under these circumstances, the stomach is apt to be particularly embarrassed by any indigestible and cold articles of food, which aggravate the affection. This state of the salivary glands, &c., seems to resemble closely that state of the skin which gives occasion to what is termed a *cold sweat* ; or that condition of the kidneys produced by exposure to cold, which in certain habits is accompanied by diuresis, &c. Such a state is always attended by a peculiar atonic condition of the nerves of the parts affected ; which nervous atony paralyses or renders the organs insensible, as it were, to every stimulus except that of water, which in consequence passes off in excess. In aged individuals who are constantly subject to this flow of watery fluid in a profuse degree, the discharge seems to operate vicariously to the kidneys, and perhaps to other organs ; and I have several times seen coma supervene on its sudden cessation.

happen, from any particular cause, to be predisposed. The inferences, however, we wish to draw from these obvious facts are, that the severe derangements of the secondary assimilating processes going on all over the system, are nearly allied to certain forms of *fever*; while the local and specific derangements are identical with certain specific *inflammations*.

In what fever and inflammation essentially consist, we do not venture to offer an opinion, but as no one will deny that certain forms of fever and inflammation are always accompanied by derangements of the assimilating processes, both primary and secondary; and that such forms of fever and inflammation are not only preceded by long-continued derangements of the primary digestive processes, but frequently have their origin in such primary derangements; we may perhaps be allowed to assume, without opposition, that *some* diseases to which we apply the terms *fever* and *inflammation*, are, *practically* speaking, at least, what we have above inferred them to be, viz. only severe derangements of the secondary assimilating processes, modified by the peculiar nature of the organs or textures in which such derangements exist—*inferences* that will enable us to explain the principles on which derangements of the primary assimilating processes predispose to the peculiar derangements of the secondary processes now under consideration; and which we consider to be nearly connected, if not identical, with those forms of fever and inflammation usually denominated *intermittent fevers*, *rheumatism*, and *neuralgia*; on each of which affections we shall make a few remarks.

The exciting causes of the diseases just mentioned are generally admitted to be some modifications of *malaria*; and, if viewed abstractedly, and with reference to their specific nature, it is probable that such modifications of malaria are the *only* exciting causes of these diseases. These diseases, however, are so generally associated with other diseases, arising from other exciting causes, that we rarely see them in their simple condition; moreover, diseases, as *hcctic*, &c., simulating them in many respects, are produced by other exciting causes than malaria, so that it often becomes a work of great difficulty, or even of impossibility, to distinguish one disease from another; and, consequently, to refer each exactly to its true exciting cause. How the dif-

ferent modifications of malaria act in producing ague, rheumatism, and neuralgia, we do not know ; but every one who has observed these diseases attentively, will probably admit, that the derangements of the assimilating organs constitute one of the first perceptible links in the series of symptoms ; and that these derangements of the assimilating organs are usually accompanied by the presence of great acidity in all parts of the system. Thus, in ague and rheumatism, during the sweating stages of the paroxysms, immense quantities of acid, (chiefly of lactic acid) are thrown off by the skin ; and sometimes by the kidneys. In these cases the saliva is commonly acid ; and, in the severe and malignant diseases of this type, occurring in tropical climates, not only the saliva, but the whole assimilating organs, and even the blood itself circulating in these organs, have been observed to be in an acid condition. Thus, as formerly stated, the dark-coloured fluid ejected from the stomach in yellow fever, and some other analogous diseases, appears to owe its colour solely to the presence of blood, which has been blackened by the large quantity of (lactic ?) acid present ; and which blood and acid must have been thrown off together from the unnatural fluids circulating in the vessels of the stomach itself. Now, the presence of so much lactic acid cannot be accounted for, except on the supposition that a certain portion of what ought to constitute, or actually has constituted, the albuminous, or, rather, gelatinous parts of the system, are decomposed or destroyed : and as gelatinous and albuminous matters or textures cannot be converted into lactic acid *alone* ; that, consequently, other unnatural and probably poisonous complementary principles are developed in conjunction with the lactic acid ; to which in part, as well as to the lactic acid, many of the secondary consequences of mal-assimilation are to be referred. In other words, the alimentary matters, which ought to be converted into albumen, by the primary assimilating organs ; and the albuminous matters of the blood, which ought to be converted by the secondary assimilating processes, into the living gelatinous and albuminous tissues, are, by the deficient or disordered operations of the vital processes, converted, in a greater or less degree, into lactic acid, and other unnatural combinations.

Such, then, are the conditions of the assimilating processes,

which we conceive to exist in the three classes of diseases we are now considering ; the next question is, what constitutes the difference between ague, rheumatism, and neuralgia, when the cause and general conditions of the system in these affections are assumed to be similar ? If our assumption be correct, the only answer this inquiry appears to admit of is, that the circumstances constituting the varieties in question are—difference in the *degree* in which the same organs are affected ; or—difference in the *seat* of disease or organs affected ; or, what is most likely—a combination of both these kinds of difference.

With respect to difference in *degree*, we do not think that this cause alone is sufficient to account for the varied character of the diseases in question. It is admitted, indeed, that difference in degree may considerably modify the character and intensity of symptoms ; but unless specific organs be actually involved, there can hardly be supposed to be any difference in the *kind* of the disease. We are, therefore, driven to the conclusion, that these different forms of disease arise from derangements in the secondary assimilating processes proper to different tissues or structures. Thus we may suppose (and the supposition seems to be rendered probable by the phenomena) that, in intermittent fevers, the primary assimilating organs, the stomach, the liver, and the spleen, are principally in fault ; that the secondary assimilating processes, by which the structure or tissue of these organs is produced and maintained, are impaired ; and that to the consequent imperfect development of these organs we may not only refer the formation of the lactic acid, and other unnatural matters, generated during the digestive processes ; but also those organic lesions and morbid hypertrophies, which are so apt to take place in the spleen, &c., during severe and long-protracted fevers of this type. In rheumatism, the same derangements, to a less extent, appear to exist in the primary assimilating organs ; but in this case, the secondary assimilating processes, by which the gelatinous portion of the muscular system and its appendages are produced and maintained, may be supposed to be more especially implicated ; and the loss of power, and the great degree of pain usually present in rheumatism, may be referred to the disorder of the numerous nerves of motion and of sense, which, as well as the fibrinous portion of the muscles, are likewise necessarily affected by the derangements.

Moreover, on these suppositions, we may explain the formation of the large quantities of the lactic acid usually present in rheumatic affections, as well as the swelling, &c.; for as all the organs are more or less involved, and their functions paralysed, not only imperfect assimilation takes place in the part affected; but the apparatus destined to remove matters which are unfitted, or no longer useful, from the scene of operation, likewise cease to act; and hence such unfitted and useless matters accumulate, and cause swelling in the part affected. In simple neuralgic affections, nearly the same explanation may be given. Derangements of the primary assimilating processes, analogous to, or identical with, those existing in ague and rheumatism, are always present in these affections; while the derangement going on in those secondary assimilating processes, by which the nervous substance and its immediate appendages are produced and maintained, may be supposed to be the immediate cause of the pain and other distressing symptoms of the disease.*

Such is a brief statement of the three most remarkable and most common of the effects of exposure to malarious influence. It is not, however, to be understood, that these comprise all the modifications of disease arising from this fertile source. When the predisposing circumstances favour such derangements, errors of the secondary assimilating processes take place in other parts, as well as in the textures named. For instance, derangements of the secondary assimilating processes take place in the mucous membrane or its immediate appendages, lining the intestines, the bladder, the urethra, &c., of which I have seen instances; and though such forms of derangement are comparatively of rare occurrence in this country, their existence is recognised and well understood in warmer climates, where malarious districts abound. I have also sometimes thought, from the similarity of the effects produced by iodine in goitre, and in certain rheumatic enlargements, that these different affections are somehow related; perhaps by having a common origin.

* The reader is distinctly required to bear in mind, that rheumatic neuralgia only is here alluded to. Neuralgic affections, arising from mechanical or other injuries of the nerves, are referable to another class of affections; but even in such instances, the formation and presence of unnatural matters of another sort may contribute to the patient's sufferings.

Treatment, &c.—The same reasons which induced us to limit our attention to the general history of the class of diseases now under consideration, induce us to confine our observations to the general principles of their treatment.

The principles of treatment to be kept in view in the present class of diseases, like the principles of treatment of most other diseases, are divided into the empirical and the rational. Knowledge founded on observation and experience, suggests to us the application of those remedies which control the diseased actions producing mal-assimilation, such as quinine and what are called tonics in general; while knowledge founded on mechanical and chemical principles, suggests the employment of those counter-mechanical or chemical expedients, which are calculated to neutralize the effects of mal-assimilation; and thus to prevent their secondary operation on the living system. These two classes of remedies are quite distinct; and though they gradually run into each other, they cannot, except in a few instances only, be substituted one for the other. In general also, the two classes of remedies are more effective when separately administered, than when associated.

In the treatment of the development of acidity during the primary assimilating processes, the first point to be determined, as far as we are able, is the nature of the *cause* which appears to give occasion to the symptom; that is, we have to inquire whether the cause lies chiefly in the stomach itself, and consists of inflammatory excitement, or of mere debility of that organ; or whether the cause lies in the inflammatory action or other disease of some remote organ; more especially of the hepatic system; or of one of the great nervous centres. When this point has been satisfactorily determined, the application of the appropriate treatment is for the most part comparatively easy. Thus, if the cause lies principally in the stomach itself, and the symptoms denote an inflammatory tendency, the due administration of local blood-letting, &c., will be found beneficial; if mere irritation be indicated, sedatives, as the hydrocyanic acid, various tonics, &c., will be found useful. If the cause be chiefly remote, as in the hepatic system, the employment of means calculated to remove inflammatory or passive congestion, as mercury and other deobstruents, will be indicated. If the cause be organic disease;

and if such organic disease lie deep in the system, as in one of the great nervous centres, very little beyond palliatives can be advantageously employed ; and it becomes as much our duty on the one hand to avoid improper remedies ; as it is on the other to mitigate, as far as we are able, the severity of the prevalent symptoms. Such are the points to be inquired into in the treatment of these derangements—points quite distinct in their character ; though in practice we find that one of them seldom occurs alone, and that all the three, not unfrequently exist at the same time. Complications of this kind are exceedingly formidable and difficult of management, and too often resist our utmost means, however skilfully applied. On the other hand, such complications are easily aggravated by injudicious treatment.

The other great class of remedies mentioned, viz. those calculated to prevent the secondary effects of mal-assimilation, are, as we have stated, usually applied on rational principles ; hence, in their application, reason should be attended to, otherwise they are apt to do more harm than good. The two great objects to be kept in view in the administration of this class of remedies, is either the mechanical object of getting rid of the unnatural material whose effects we wish to obviate ; or the chemical object of neutralizing the acid, and other unnatural products of the primary assimilating processes. Now, as both these objects have reference to certain periods, and depend upon the *time when* the assimilating organs are called upon to perform their duty ; it is obvious, that to obtain the utmost benefit of this class of remedies, their administration must in a great degree be regulated by such periods.* Thus the acid *residua* of a meal should be neutralized

* The injudicious use and abuse of alkaline remedies in acidity of the stomach is often a source of great mischief. Alkalies, as stated in the text, exert no curative effect ; that is, they will not prevent *future* acidity. On the contrary, when taken in large doses, and at improper times, the effect of alkalies is to cause an absolute increase of acid. Thus, when a large quantity of alkali is taken into an empty stomach, the immediate effect is, that the stomach, in endeavouring to resume its natural condition, throws out an additional quantity of acid to neutralize the redundant alkali. When alkaline remedies, therefore, are injudiciously persisted in, a daily contest arises between the stomach and the doctor. If the constitution be sound, the stomach, in spite of the doctor, usually gains the ascendancy ; but at the expense of extraordinary labour in the secretion of a greater quantity of acid.

when the digestive processes are completed ; that is, usually from three to six hours after the meal has been taken ; and for this purpose, even in the worst cases, from ten to twenty or thirty grains of the carbonate of potash will be quite sufficient. To the carbonate of potash, I find that four or five grains of nitre may be usually added with good effect ; though I do not pretend to explain its *modus operandi*. Those who wish to prevent the distressing secondary effects of acidity in the *primæ viæ*, must steadily persist in the use of this remedy daily, not for a few days or weeks, but until the affection has been entirely subdued by other means, viz. by the joint effects of appropriate diet and medicines ; for it should be constantly borne in mind that alkaline remedies have no effect in *preventing acidity* ; their effects are solely confined to *neutralizing the acids already formed*.

When acidity prevails in the lower portion of the intestinal canal, and particularly in the cœcum, the treatment must be modified to meet the circumstances. The soluble antacids in this case have comparatively little effect, from their being neutralized and absorbed before they reach the seat of the affection ; hence the *insoluble* antacids, and particularly magnesia, will in

If, on the contrary, the vital powers of the stomach be weak, the doctor may conquer, but at the risk of still further enfeebling the vital powers of that organ ; and in both instances the general result will be, that the diseased functions of the stomach producing acidity will be augmented rather than improved. The beneficial effects of alkaline remedies, therefore, are confined, as we have stated, to the *neutralization of acids already formed*, and thus of preventing their secondary effects on the system. The primary derangements of the vital operations, on which the morbid formation of such acids depend, must be combated by the empirical means before spoken of. As mere antacids, the alkaline carbonates are in general infinitely preferable to the pure alkalis. To obtain their maximum effects also, they are usually much better exhibited alone. Those who combine antacids with tonics generally defeat their purpose, both with respect to the antacid and the tonic : as, to ensure their maximum effects, the two classes of remedies require to be given at totally different times, relatively to the digestive processes. Some gouty dyspeptics, who have been accustomed to the use of strong wines and high seasoned dishes, derive temporary relief from taking soon after dinner a bitter infusion, or warm tincture, as of ginger, &c., mixed with a little carbonate of soda or ammonia ; but the effects of such remedies should be watched, for while they appear to lull the complaint, they in reality often foster it, and render its permanent removal more difficult.

general be found more useful in such cases. The shortest mode, however, of getting rid of the immediate inconvenience of acidity in the lower bowels, is to inject a pint or two of warm water, (or of soap and water,) and thus of removing the offending cause. By this simple remedy I have often seen the severe nervous headaches, and other unpleasant symptoms accompanying acidity in the lower bowels, immediately removed. Those who suffer from such causes usually require the aid of purgatives, which in general are better taken at bedtime. Purgatives of a mild but effectual kind, the action of which is chiefly exerted on the lower bowels, such as the *Decoct. aloes comp.* or *pulvis aloes comp.* with magnesia, often suit well; as do pills taken at a late dinner, if duly adjusted to the circumstances of the case. Drastic purgatives in general should be avoided; for though they sometimes give immediate relief, they usually leave the patient more inveterately disposed to the disease. Neither this class of diseases, nor the remedies adapted to remove them, have been so carefully studied as they deserve to be. We shall have occasion to revert to them hereafter.

In what is called a bilious attack, one of the indications, in almost all instances, is to relieve the congested viscera by appropriate purgatives. If the patient has not been accustomed to the stimulus of mercury, this active remedy will scarcely be required in the slighter instances: if he has been so accustomed, nothing probably but mercury will remove the congestion, and set the system free. Bilious attacks are so common among the indolent and over-fed inhabitants of great towns, that everybody, patients as well as doctors, think they understand them, and treat them accordingly. The truth is, however, that these derangements are not half so well understood as they are supposed to be; and that there is no class of diseases, particularly as they occur about the middle or stationary period of life, requiring greater discrimination or judgment on the part of the medical practitioner; on whose mode of treatment very often depends not only the future comfort, but sometimes even the very existence, of the patient.

We have stated that the congested condition of the assimilating organs now under consideration, strongly predisposes to disease in those parts of the system, which, from original or accidental

causes, are weaker or more obnoxious to disease than the others. It becomes, therefore, the duty of the medical practitioner to study the weak points of the patient's constitution, and to direct his remedies accordingly. Calomel pills and black doses will not do for all ; and when misdirected, they too often bring on irreparable mal-assimilation and its consequences. As, however, the affections to which this congested state of the system predisposes, and with which it is complicated, are so numerous, details are out of the question. Some of these complications have been already described ; others will be noticed in subsequent parts of this volume ; while many of them fall entirely without the range of our present design. The principal object in noticing the subject in this place is to arrest attention ; and to show that one of the complaints of the most frequent occurrence, is likewise one of the greatest interest and importance.

We pass on to the treatment of ague, rheumatism, and neuralgia—affections generally admitted to result from exposure to malarious influence, and to which those who are already predisposed by the derangements of the assimilating organs above described, seem to be particularly obnoxious. The same reasons which induced us to avoid detailed descriptions of these diseases, now limit us to the general principles of their treatment.

In obstinate attacks of either of the above diseases, the remedies of first application usually partake of a rational character, or are such as are calculated to remove unnatural accumulations or congestions mechanically impeding vital operation ; as blood-letting, general and local ; purgatives ; &c. These objects being accomplished, we resort to our empirical remedies ; that is, to general or specific tonics, stimuli, or sedatives, or to various combinations of such remedies ; with the view of removing, as far as we are able, the immediate urgent symptoms, and of restoring the languishing vital powers. In conjunction with these remedies, the secondary effects of the mal-assimilation always present in such derangements, should be attended to and obviated by appropriate counter-agents. Of the secondary derangements, as we have said, *acidity* is always one ; though, as the acid developed is usually the lactic or some other destructible acid ; for the reasons formerly given, no less than from the remote situations in which the acid is developed, alkalis are not so immediately bene-

ficial in the diseases under consideration, as they are in those affections in which their development is limited to the *primæ viæ*. On the contrary, in many of these cases, particularly when the spleen is affected, the mineral acids, combined with quinine and iron, are often found most beneficial.

CHAPTER III.

GENERAL OBSERVATIONS ON THE PATHOLOGY OF ALBUMINOUS
ASSIMILATION AND SECRETION.

ALTHOUGH the assimilation of albuminous principles, in some form or other, is probably requisite to all the more perfect animals, and cannot be long, if at all, suspended without destroying their existence; yet, as far as regards the human subject, the *primary* assimilation of *animal* albuminous matters may certainly for a time, if not altogether, be dispensed with. Whether the primary faculty of assimilating vegetable albumen or gluten, and the caseous principle of milk, can be permanently suspended, is not known; but my belief, as just stated, is, that the function of assimilating albuminous matters, taken in its *general* sense, like the function of assimilating the organised saccharine principle, is never entirely suspended; in other words, that the complete suspension of this function is equivalent to the death of the organised being.

The phenomena and symptoms attending the non-assimilation and mal-assimilation of albuminous matters, vary so remarkably, that their general relationship will be better understood after they have been described in detail. We shall proceed, therefore, at once, to describe the most remarkable derangements resulting from the causes stated; and as these derangements are most prominently marked, or at least are best identified, by the changes they induce in the urinary secretion; we shall make the changes thus induced in the urinary secretion the basis of our arrangement

and description. In other words, we shall consider the urinary derangements as constituting so many distinct diseases, under the following heads or *sections*.

- Section a.* Derangements of the assimilating processes, accompanied by excess or deficiency of urea in the urine.
- b.* Derangements of the assimilating processes, accompanied by the presence of albuminous matters in the urine.
- c.* Derangements of the assimilating processes, accompanied by the presence of lithic acid and its compounds in the urine ; and,
- d.* Derangements of the assimilating processes, accompanied by the presence of cystic oxide, xanthic oxide, hippuric acid, &c., in the urine.

In a review of these four classes of derangements, at the end of the chapter, the nearly allied subject of *Struma* will be briefly considered.

SECTION a. Of an Excess and Deficiency of Urea in the Urine.

Before the first edition of this work was published in the year 1821, the diseases connected with a derangement of the quantity of urea in the urine were little understood, and seem to have been confounded with other diseases. Since that time they have attracted more attention ; though even yet they have not obtained that consideration among medical men which their importance demands.

Of Affections connected with an Excess of Urea in the Urine. —The proportion of urea in healthy urine is such, that on the addition of nitric acid, at ordinary temperatures, no crystallisation takes place till the urine is concentrated by evaporation. In a variety of cases, however, the quantity of this principle is so increased, that crystallisation takes place on the addition of nitric

acid, without any previous concentration of the urine; and in many such cases, on analysis, we find that this excess of the urea is not only absolute but relative; that is, the quantity of urea in the urine is not only absolutely greater than natural, but relatively far greater to the other ingredients, than it is, or ought to be, in the healthy secretion. Now this absolute and relative excess of urea in the urine gives occasion to two forms or rather modifications of disease, which, as in diabetes, are chiefly distinguished by differences in the quantity of urine passed, viz. *Excess of urea without diuresis*; and *Excess of urea with diuresis*. These two forms of disease, precisely as in diabetes, without or with diuresis, sometimes gradually pass into each other in the same individual; and in fact they seem to differ from each other little more than in degree. In the first form of the disease, the quantity of urine passed seldom much exceeds the healthy standard; and in this case the quantity of urea is both absolutely and relatively greater than in health. In the second form of the disease, the quantity of urine is sometimes excessive; and in this instance the quantity of urea, in a given specimen of urine, may be less than in health; though the quantity of urea relatively to the other ingredients may be greater than natural; and the absolute quantity of urea passed in a given time, may thus, as in the other modifications of the disease, exceed the natural standard. Before the period above mentioned, as just stated, neither of these forms of disease seems to have been distinctly recognised; and the second form in particular, when it attracted attention at all, was usually confounded with diabetes.

It will be proper to notice, before we proceed, that when the specific gravity of the urine is high—for example, above 1.030—the absolute proportion of urea, in common with the other principles, is necessarily larger than natural; and in this case, spontaneous crystallisation will frequently take place in such urine on the addition of nitric acid.* This concentrated state of the urine

* I have reason to believe that when large quantities of the citrate (and perhaps other salts) of ammonia are taken by dyspeptic patients, it is sometimes converted into urea. The greatest excess of urea I ever saw, occurred in the urine of a dyspeptic hypochondriac who was in the habit of taking large quantities of the citrate of ammonia. On leaving off the ammoniacal salt, the quantity of urea immediately became and continued normal.

is not of unfrequent occurrence in dyspeptic and febrile affections ; and depends on a diminished secretion of water only. Hence, though this abundance of urea, as in all other cases, may be considered as indicative of disease ; yet in such instances it is obviously no more indicative of disease than the abundance of the other principles, and consequently leads to no particular plan of treatment ; which must be regulated by the general nature of the affection.

In other instances, not only an absolute, but a relative excess of urea is occasionally present in the urine. This happens, for instance, occasionally in the urine of children, as well as of adults, when the secretion abounds in unnatural deposites of lithate of ammonia, oxalate of lime, &c., or of the triple phosphate of magnesia and ammonia. In such cases, however, more obvious and urgent symptoms are commonly present, and those become so prominent as to constitute the characteristic feature of the derangement. Hence the symptom of an excess of urea, though important, must be considered as subordinate ; and our practice, as before, must be regulated by the more prominent and characteristic symptoms of the disease.

In the first form of the disease now under consideration, distinguished by the presence, both of an absolute and relative excess of urea, the average specific gravity of the urine seems to be a little above 1·020 ; and occasionally to vary from 1·015 to 1·030, or even higher. Most generally the secretion is transparent, and pale coloured ; but occasionally it assumes somewhat the appearance of porter diluted with water ; and this variety in colour not unfrequently takes place in the urine of the same person. When first voided, the urine reddens litmus paper, and consequently has the usual acid reaction of healthy urine. For the most part also, as just stated, it is entirely free from sediment, except the mucous cloud invariably present in the secretion ; and the only remarkable property which it appears to possess, is that of containing so much urea as to speedily form a crystallised compound on the addition of nitric acid. Urine containing a large proportion of urea, is prone to decomposition, and in warm weather, therefore, generally soon becomes alkaline.

Those who are subject to this form of the disease, have usually a frequent and urgent desire of passing water both by night and

day. This frequent desire of passing water, which seems to be principally occasioned by an irritable sensation referred to the neck of the bladder, and occasionally extending along the urethra, is sometimes also referable, in part, to actual *diuresis*; that is, to an increased quantity of urine in the bladder; though it can be rarely ascribed to this cause alone, as the quantity of urine passed at one time is often by no means large. In almost every instance, however, even of the form of disease now under consideration, which has fallen under my notice, the quantity of urine voided in a given period, as in twenty-four hours, has appeared to be somewhat above the natural standard. The quantity also is particularly liable to be increased by causes which would scarcely affect a person in perfect health, at least in the same degree; such as by a chilly state of the atmosphere, mental emotion or excitement, &c.

Besides the symptoms immediately referred to the urinary organs, there is sometimes a sense of weight or dull pain in the back, accompanied by a disinclination to bodily exertion. The patient also complains of more or less uneasiness in the assimilating organs, though the tongue usually presents nothing peculiar, and there is no remarkable thirst; nor craving for food; nor emaciation. Moreover, the functions of the skin appear to be little deranged; hence perspiration, from the fatigue it is apt to produce, often readily takes place under exercise. In short, though there is great susceptibility to derangement, as well as to actual disease of the assimilating and other functions, I am not aware that any one derangement of any one organ can with certainty be pronounced to be characteristic of an excess of urea in the urine.

In the second modification of the disease, in which the quantity of urine passed is excessive; besides most of the symptoms above enumerated in an aggravated form, there exist more or less of thirst and morbid craving after food. The patient likewise complains of general coldness and great bodily weakness. In some instances also there is considerable emaciation; though not to the same remarkable extent as in Diabetes.

The *causes* predisposing to an excess of urea in the urine, seem to be nearly allied to those predisposing to diabetes; hence the tendency to the disease, like the tendency to diabetes, is probably often inherited. With such an inherited or constitutional pre-

disposition, a variety of circumstances, having no common character, except that of alike enfeebling the vital powers, and more especially the spinal nerves, will, as in diabetes, give occasion to the development of an excess of urea in the urine. Among such circumstances I have observed an abuse of the sexual powers in early life as one of the most frequent. Next to this has been long-continued and severe dyspepsia from inattention to diet; intemperance in the use of fermented liquors; mental anxiety; mercurial irritation, &c.; while in several instances I have not been able to elicit from the patient any circumstance to which the disease could be reasonably referred.

Most of the subjects of the disease in the forms above described, which I have hitherto seen, have been middle-aged men, of thin and spare habit, with a sort of hollow-eyed anxiety of expression in their countenance; unusually nervous and susceptible, but by no means always hypochondriacs; and free also from gout, and, as far as could be ascertained, from structural disease of the urinary or of any other organs. In general, the subjects of the slighter form of the disease had been induced to apply for medical advice, not so much from actual suffering, as from the inconvenience of the disease, and the dread of its ending in something worse: while those who laboured under the severer forms of this affection, imagined that their disease was diabetes, and had been sometimes treated accordingly by the medical men they had consulted. Perhaps it may be worth while to mention, that though in various uterine affections, I have repeatedly seen a temporary excess of urea in the urine; I have hitherto only met with one well-marked instance of the permanent disease in a female.

With respect to the *proximate* cause or intimate nature of the disease; I have been long of the opinion that it depends on derangements of the secondary assimilating processes, more frequently than of the primary; and that the chief source of urea in the system is that peculiar modification of the albuminous principle distinguished as gelatine; which, as is well known, is not found in the blood, nor in any previous stage of the assimilating processes; but is developed only during the secondary assimilating processes. To the same source we have referred *in part* the saccharine matter in Diabetes; also the lactic and other acids

immediately allied in composition to the saccharine principle ; (that is, composed of carbon and water;) or derived from the saccharine principle, as the oxalic acid, &c.; all which principles seem to be complementary to urea and its derivatives ; in other words, the gelatinous principle is changed into urea and its derivatives on the one hand, and the saccharine principle or its congenerous acids and derivatives on the other. This apparent relationship between the different principles mentioned, has induced me to consider the present disease in immediate connexion with Diabetes, and the diseases associated with unusual development of the lactic acid, &c., in the last chapter ; of many of the phenomena of all which diseases it offers an explanation. The same relationship will also enable us to explain the fact, now I believe universally admitted by physiologists ; that the greater portion of the urea found in the urine is not formed in the kidneys, but elsewhere in the system ; and that these organs are little more than the outlets, by which, as an excreted principle, urea is removed from the economy.*

If I might venture to express an opinion founded on the experience of the last twenty-five years, since I first recognised the disease, I should say that the present affection is rare ; for where I have seen one decided case of an excess of urea in adults, I have seen twenty cases of diabetes.† There is reason, however, to believe, that this unusual occurrence of the disease is more apparent than real : and that, in a great variety of instances, patients do not apply for medical advice till the complaint has merged into diabetes or some other disease, to which it often constitutes the transition step. That the disease, if permitted to proceed unchecked, or if injudiciously treated, passes into diabetes or some other for-

* I do not believe that the kidneys are entirely passive with reference to this point ; and think it not improbable that in some instances imperfectly developed urea may be formed in the system, which, in subsequently passing through the kidneys, is reduced to the crystallized form. Indeed it is most likely that in the healthy condition of the system this is the rule ; as it seems to be with respect to lithic acid. The salts of ammonia also, which in certain cases of severe dyspepsia, appear to escape the assimilating processes, may perhaps in some instances be converted into urea in passing through the kidneys. See note, page 95.

† The second form of this disease in particular, is so rare, that no instance of it has occurred to me since the last edition of this work was published.

midable disease, (perhaps the disease to be next considered,) I have the strongest presumptive evidence, both from observation and analogy; but I have hitherto had no positive proof of such a termination; for every instance of the affection which I have yet seen in adults, has yielded more or less readily and completely to the means recommended.

Treatment.—In the first place, with respect to diet; this should be light and nutritious, but not stimulating; and in general should consist principally of animal and farinaceous matters. If the patient has been accustomed to the use of fermented liquors, a small quantity of the more generous wines, or sound porter, may be allowed; but all diluent and diuretic fluids should be abstained from as much as possible; and he should avoid indulging his thirst, the gratification of which, as in Diabetes, will only aggravate the disease. Moderate exercise, either on foot or horseback, will be proper; but fatigue, both bodily and mental, should be carefully shunned; and, as far as it is possible, the patient should endeavour to divest himself of mental anxiety of every description.

From the various forms which this disease assumes in different individuals, no plan of medical treatment can be laid down that will be found strictly applicable in all instances. The great principle to be kept in view is to do no harm by rough treatment. Calomel pills, black doses, and saline purgatives, are calculated to do infinite mischief, and will probably render a manageable disease perfectly unmanageable. Hence, though the use of purgatives and alteratives is often indicated, and even necessary, more especially in the earlier stages of the disease; they must be employed with caution, and their effects carefully watched. In both forms of the disease, and particularly in the second, sedatives are usually required, and of these opium is the chief. With the sedatives may be conjoined such tonics as seem to be suited to the individual habit; and as the complaint recedes, and the health becomes re-established, the sedatives may be gradually withdrawn. Such are the *principles* of the treatment I have usually found most beneficial; the details, of course, must be suited to the circumstances, according to the judgment of the practitioner.

The following cases are given as illustrations of the two forms of the disease in adults; and of the modes of treatment.

The subject of the first case, which originally drew my attention to the disease, was a gentleman about forty years of age, whose general appearance and history coincided precisely with those above given in our general description of the disease. He had been subject to the complaint a considerable time, but latterly had become worse, and he had now a frequent desire to pass water; especially when under the influence of mental agitation, or when exposed to the cold air. The urine was generally of a brown porter colour, and not much more abundant than natural. The specific gravity of the specimen I examined was 1.0237. In this specimen the quantity of urea was most strikingly abundant; and there was also a little lateritious sediment. He informed me that he occasionally passed urine of a very pale colour; and when this happened, the quantity was greater, and the specific gravity probably lower. He had no thirst; and the functions of the skin appeared to be natural. He had lately, however, recovered from a feverish attack, and he felt occasionally an uneasiness in the region of the liver; the tongue also was slightly furred, and the bowels irregular. From these symptoms I at first supposed the disease was nothing more than a common case of dyspepsia, connected with derangement of the hepatic system and general health; and accordingly ordered him mercurial alteratives with purgatives, and the usual means commonly resorted to on such occasions. About a month afterwards I again saw him. The urine was now free from sediment, and its specific gravity was reduced to 1.019; but it still exhibited the same brown colour, and the same great excess of urea as before; and though his general health was evidently improved, the urinary complaint was in no degree diminished. He was ordered a bitter infusion, containing the *liquor potassæ* and opium; and directed to regulate his bowels by the occasional use of the alterative laxatives previously prescribed. Under this plan the complaint became better in a few days; and in three weeks afterwards, when I again saw him, was very considerably improved. The urine, indeed, presented the same appearance as before; but its colour was lighter; its specific gravity reduced to 1.0155; and the proportion of urea, though still excessive, was diminished. By persevering in the plan mentioned for some time, he became almost entirely free from the complaint; and continued well for some months; when it returned again in a

slight degree. Similar means were again had recourse to, and the disease again yielded; after which time it returned at intervals of some months, (more frequently during the winter,) but always gave way on the use of opium in very moderate doses, as, for example, *gutt. x* or *gutt. xii.* of the *tinct. opii* in a glass of soda water once or twice a day. This state of things continued for a considerable time, the urine never becoming absolutely natural. He then consulted me about the propriety of marrying —a step which I strongly urged him to take. For several years after this I heard nothing of him; when he came to me on account of some dyspeptic symptoms. The urine was still unnatural, but on the whole improved; and he stated that soon after I last saw him he had followed my advice and married, and had now three children, with every prospect of more.

The second case I shall relate is one that occurred to Dr. Elliotson, at St. Thomas's hospital; who furnished me with the urine for examination every week, so as to enable me to ascertain the effects of the remedies employed.

March 6th, 1819.—Rodman, aged fifty-five. Symptoms resembling those of Diabetes. There is constant craving for food; a sense of cold over the whole body; and a frequent desire of passing urine; which in twenty-four hours amounts to *sixteen pints.*

The urine of this man was pale-coloured; its specific gravity was 1·020; and it contained a very large proportion of urea; but not the least particle of saccharine matter. On standing, it also deposited crystals of lithic acid. Ordered—*opii gr. 1½ bis die.**

March 20.—Feels much better. Urine reduced to two pints in twenty-four hours. *Pergat.*

The urine was now somewhat deeper coloured; and deposited a copious sediment consisting partly of lithic acid crystals, and partly of lateritious sediment. Its specific gravity was increased to 1·0344; evidently from its having become more concentrated than natural. The quantity of urea was abundant, but not in the proportion in which the urine was concentrated.

This man became so well shortly after the above date, that he did not return to the hospital till

* Opium in this case was ordered by Dr. E.. on the supposition that the disease was Diabetes.

August 19.—Disease returned six weeks ago. Feels as ill as ever—very weak. Bowels costive. Quantity of urine in twenty four hours about four pints. Ordered—*opium* as before.

The urine was now transparent. Its specific gravity was 1.023, and urea was abundant.

Under the above plan he again speedily became better, and soon afterwards ceased to attend at the hospital. In September of the following year, however, he again applied to Dr. E. on account of another and very different disease. The specific gravity of the urine was now 1.0282. It abounded in lithic acid, *but contained no excess of urea*; and he had been quite free from his former complaint for upwards of twelve months. With the subsequent history of this person I am unacquainted.

These cases may be considered as illustrative of the two extreme forms of this disease; which, probably, for the reasons already stated, appears to be rather uncommon as an idiopathic affection. A variety of intermediate grades of the disease have, however, occurred to me, some of which have been distinctly marked; others complicated with different complaints requiring peculiar treatment. In one instance, the affection occurred in a young man, whose mother and uncle had died of diabetes. In another, it accompanied a deposition of the phosphates in the urine. In several instances, I have found an excess of urea associated with epilepsy, and other nervous affections. Hence, in whatever circumstances an excess of urea in the urine may be found to occur; whether as denoting a peculiar state of disease, or as complicated with more urgent derangements, it is always a symptom of such importance, that it ought to be known to the physician; who, if he has duly studied its pathology, will generally be able to apply his knowledge, either directly or indirectly, to the patient's advantage.

Of affections generally connected with a Deficiency of Urea in the Urine.— If we suppose the extrication of urea from the system to be as necessary to the well-being of all the more perfect animals, as the extrication of carbonic acid from the lungs; it is probable that there is no state of existence compatible with life, in which urea, or its equivalent, carbonate of ammonia, does not exist in the urine. This accords with my experience; for I have never found a specimen of urine, which, when recently

passed, did not, on examination, prove to contain more or less of urea, or of its equivalent, carbonate of ammonia. There are, however, several forms of disease, both in adults and in children, in which the proportion of urea is not only absolutely, but relatively, less than in healthy urine ; and though these forms of disease are rarely of that distinct character as to be pronounced idiopathic ; and in fact are often referable to other forms of urinary disease ; yet it may not be deemed superfluous to bring together under one head, and in a summary form, a few of the more remarkable of these forms of disease.

With very few exceptions, a prominent symptom of all the different forms of disease to be now considered, is *diuresis*. That is, the quantity of urine passed is not only greater than natural ; but often *much* greater than it ought to be. These diseases, like the preceding, are somewhat different as they occur in adults, and as we formerly described them in young children.

Deficiency of urea, accompanied by diuresis in adults, may be considered under the heads of *diuresis intermittens*, and *diuresis continua*. Perhaps the nearest approach to an entire absence of urea in the urinary secretion, occurs in hysteria. Hysteric diuresis, however, is distinguished by being *occasional* ; while, in the intervals, urine is often passed containing a greater proportion of urea than natural. Hysteric urine has often a specific gravity scarcely exceeding that of spring water ; and as passed, is limpid and colourless, and nearly free from sensible properties of every kind. When much concentrated, however, by evaporation, hysteric urine always, according to my observations, displays sensible colour and odour ; and if examined in this condition, not only yields traces of saline matters, but of urea. Hysteric urine has sometimes a disagreeable odour when passed ; and in almost all instances soon acquires a putrid smell, like that of cabbage water ; becomes more or less opake ; and deposits crystals of the triple phosphate of magnesia and ammonia ; especially in warm weather. Urine of this description is not exclusively passed by hysterical females ; but is occasionally voided by individuals of the other sex. In general the affection requires no specific treatment, but yields to appropriate remedies in common with the other symptoms of hysteria. It may also be remarked, that many nervous individuals, who cannot be said to be hysterical, or to be

subject to any urinary disease, often pass large quantities of limpid urine on exposure to cold, and to various other exciting influences; but such urine generally differs from hysterical urine in being only *very dilute* healthy urine; while in hysterical urine the relative proportions of the ingredients are always deranged. This form of diuresis, however, probably runs into hysterical diuresis by such imperceptible grades, that it is not possible to draw the line of distinction between them. I am not aware that the intermittent form of diuresis, connected as it usually is with mental emotion, occurs in young children.

Besides hysteria, and the affections here alluded to, a variety of diseases, strictly speaking of a urinary character, are likewise subject to occasional diuresis. Of some of these we have already spoken; and of those which remain to be noticed in subsequent chapters, we may mention certain forms of albuminous urine; of acidulous and alkaline urine; of urine depositing the phosphates, &c., all of which will be fully considered when we come to speak of these subjects. My object in mentioning them here is chiefly for the sake of analogical illustration.

The diseases confounded by authors under the general name of *diabetes insipidus* have been probably, as already stated, very various in their nature. In some instances they appear to have been referable to that class of diseases connected with an excess of urea; at other times they seem to have belonged to forms of disease to be subsequently mentioned. Most generally, however, they appear to have been referable to the class of diseases to be now considered; and which may be included under the general definition of diseases in which the quantity of urine passed within a given time is always greater than natural; while the quantity of urea contained in the urine is relatively less than in healthy urine.

In this class of diseases the urine voided in a given time is *constantly* much above the healthy standard; the patient usually drinking in proportion. Cases are related, in which the quantity voided in twenty-four hours has amounted to twenty pints, or even much more; and that for a long time together. In these cases the urine is almost as colourless as water; at other times it is of a very light straw colour; and its specific gravity in these instances is found to vary from the specific gravity of spring

water, (that is, 1·001 or 1·002,) to 1·008 or 1·010. The more dilute specimens of urine are commonly quite neutral; but the heavier specimens have sometimes a faint acid reaction. The proportion of urea, as compared with that of other ingredients, is usually less than natural; hence such urine, on being kept, often acquires a putrid or sour, rather than an ammoniacal smell. There are many exceptions, however, to this observation, even in the urine of the same individual; for, on account of the rapid and incessant action of the kidneys, fluids taken into the stomach are absorbed, and elicited as urine almost as soon as they are swallowed; hence the qualities of the urine are liable to be much influenced by those of the fluids taken.

The constitutional symptoms in these diseases are subject to considerable variety; but there is always great thirst; a dry state of the skin;* and usually a constipated state of the bowels. In most cases, there is an uneasy sensation referable to the stomach, accompanied by a morbid craving for food; at other times this sensation merges into nausea, and there is a perfect indifference to solid matters; which are almost immediately ejected by vomiting. There are also more or less of emaciation; depression of spirits; and great muscular debility, with all their consequences.

Of the *causes*, predisposing or proximate, of this affection, I fear little can be said in addition to what has been already stated. Diuresis in this, as well as in all its other forms, has been supposed to occur most frequently in individuals of a *nervous* temperament,

* As in diabetes, the quantity of urine passed often appears to exceed the fluids taken. In such instances absorption must take place through the skin or lungs, or both. Dr. Watson gives a remarkable and well-authenticated instance of this, as occurring in a boy of eleven years old, who laboured under the present affection, and passed nineteen pints of urine daily of specific gravity 1·002 or lower. This boy I saw through the kindness of Dr. W., and suggested the abstraction of fluids, and at the same time weighing. On making this experiment, it was found, that in the course of an hour of complete abstinence, the boy became a pound heavier; and that on passing a pint of urine at the end of the hour, he again recovered his original weight. This pound of fluid, therefore, must during that short period have been imbibed from without. He left the hospital, after every means were tried, in the same state. See *Lectures on the Practice of Physic*, by Dr. Watson. *Med. Gazette* for June 10, 1842.

as it is termed ; and hence the present form of the disease seems to have been viewed somewhat in the light of a perpetual state of hysteria. There may be some truth in this remark ; though I think I have seen instances of the affection in which the remark has been inapplicable ; and in which the nervous condition of the patient, if not produced, has been certainly much aggravated, by the perpetual harassment caused by the large flow of urine.

According to my own observation, which seems to agree with that of others ; the present form of diuresis occurs in both sexes, and at different ages, though it seems to be more frequent in women and in both sexes about the middle period of life. Sometimes, as already stated, it appears to be the natural consequence of the form of diuresis connected with an excess of urea. At other times it cannot be referred to any distinct cause.* My belief is, that it is often connected with, or leads to, incipient disease of the kidneys ; and if this opinion be correct, it may occasionally pass into one or other of the forms of disease to be considered in the next section.

The present form of diuresis, as it occurs in old people, particularly in old men, requires to be briefly noticed, before we speak of the prognosis and treatment.

The diuresis of old people, and particularly of old men, is often accompanied by a deficiency of urea ; but in all the instances in which I have hitherto noticed the affection, it has been associated with some apparent organic disease, either of the kidneys or neck of the bladder, or with both ; to which, as causes, the diuresis appeared to have been chiefly referable. The urine in these cases is often alkalescent or slightly serous ; and hence the consideration of the affection, which can hardly be considered as idiopathic, properly falls to be spoken of elsewhere.

Diuresis, with a deficiency of urea, from its deep-seated character, is generally a disease of great obstinacy, and yields with difficulty to medical treatment ; even, when for a time it appears to give way, it is apt to return from the slightest cause. As one of the most frequent terminations of the affection seems to be dis-

* I have seen the disease occur several times in individuals residing in very damp situations, surrounded by stagnant water ; and who have at the same time been exposed to much mental anxiety.

ease of the kidneys and its consequences ; this form of diuresis generally proves fatal from dropsical effusion or coma.

Treatment.—The treatment of diuresis with deficiency of urea, as just stated, is exceedingly difficult, and the complaint often baffles all our attempts. Many of the observations applicable to diabetes apply to this form of disease also, and need not, therefore, be repeated ; hence we shall confine our present observations to a brief recapitulation of the leading points. One of the first great principles to be attended to, is, as much as possible, to restrain the patient from drinking ; for if he be allowed to drink *ad libitum*, it is in vain to hope for benefit from any plan of treatment. Another point to be kept in view, is to promote cutaneous action. For this purpose the vapour bath and friction, assisted by the internal use of Dover's powder, antimony, &c. ; or, if the patient's circumstances admit, removal to a warm climate ; will be found highly serviceable. Tonics of every kind usually disappoint our hopes ; and the more active tonics especially, often increase the thirst. As in diabetes, I have seen more benefit derived from the means above stated, joined to the judicious use of sound porter and a system of diet chiefly consisting of animal and farinaceous matters, than from any other means. The bowels should be carefully regulated ; but I have obtained no permanent good from active purgatives. Active purgatives for a time, indeed, divert the fluids to the bowels, and the urine, consequently, is diminished in quantity ; but as soon as the effects of the purgatives cease, the diuresis returns in an aggravated form. I have occasionally seen benefit from the frequent application of blisters over the loins. It is proper, however, to observe that this affection varies so remarkably in different individuals, as to preclude the notion of any specific plan of treatment. As illustrations of the disease, generally, and of this remark in particular, I give a summary history of the following cases.

The first case I shall relate, occurred to me several years ago. The patient was a young gentleman, about twenty years of age, who had laboured under the affection for a long period, during which almost every means that could be devised by the most celebrated of our metropolitan physicians had been resorted to in vain. When I saw him, the symptoms were those of the affection as before described in their well-marked form ; and the

urine, which varied from six to ten pints in twenty-four hours, was transparent, of a pale straw colour, of a very low specific gravity, and deficient in urea. I tried different means without any decided benefit; but I subsequently learnt, that soon after I ceased to attend him, family misfortunes reduced him from a state of comparative affluence to the necessity of exerting himself for obtaining the means of subsistence; that under this misfortune, the dormant powers of his constitution rallied, and his complaint gradually subsided; and finally that he became so well as to be enabled to accept a situation in South America; since which time I have not heard of him.*

The second case to be noticed, occurred in a female between sixty and seventy years of age. The affection commenced imperceptibly during a residence in a damp situation and exposure to mental anxiety. After a few weeks the quantity of the urine became so large as to attract her attention; the thirst also began to be troublesome; and, by indulging in the use of drinks, the quantity of urine rapidly increased to sixteen or eighteen pints in the twenty-four hours. In this state I first saw her. The urine was limpid and colourless; its specific gravity ranged from that of spring water to about 1·005; and the urea and all the urinary ingredients were deficient in quantity. The symptoms were urgent thirst; a dry and brown tongue, with imperspirable state of skin; almost complete loss of appetite, at least for solid food; occasional nausea and vomiting; a deranged and constipated state of the bowels; great restlessness and want of sleep, with much emaciation and debility. She was put upon a plan of diet chiefly animal, with the moderate use of porter, and strictly enjoined to abstain from drinking watery fluids; and by the aid of this diet, and of gentle tonics and aperients, she became so much better, that in a few weeks the thirst had nearly left her; and the quantity and quality of the urine had assumed their natural condition. It is worthy of remark, that this patient suffered much from troublesome boils during the progress of the disease; though I could detect no sugar in the urine. I have not since heard of this patient.

* I have recently met with another case in a youth of seventeen. Various means have been tried, but hitherto without success.

Another case occurred to me under precisely similar circumstances, in a middle-aged female. She stated that having been unexpectedly reduced to poverty, she went to reside with a friend in a low unhealthy situation, surrounded by stagnant ditches and sewers, on the banks of the Thames at Limehouse. Soon afterwards she became much troubled with boils, and at length with diuresis, which made its appearance rather suddenly. The quantity of urine passed daily was very large, its specific gravity little above that of water, and the thirst intolerable. She was put on a plan similar to the above, but I did not learn the result.

I have recently seen another case in which the patient, a married lady, has become pregnant. When I last heard of her the complaint continued without much variation. The case had existed for a considerable time with remissions, and was associated with a cutaneous affection.

For an account of the present forms of disease as they occasionally occur in young children, the reader is referred to the preceding chapter, page 58.

SECTION b. *Of Albuminous Urine.*

Before the appearance of the second edition of this work, the subject of albuminous urine had acquired considerable notoriety in this country from the labours of Dr. Wells and Dr. Blackall; but since that period, an albuminous condition of the urine has attracted more than usual attention, both here and on the continent, and been the subject of much discussion, and of some controversy. Into this discussion it is not my intention to enter controversially; but after briefly alluding to what has been done in the inquiry, I shall proceed to give the result of my own experience and views on the subject.

The attention of the medical public was more particularly drawn to an albuminous condition of the urine and its consequences, by the publication in 1827, of Dr. Bright's "Reports

of Medical Cases;" in one of the chapters of which work he attempted to prove, that an albuminous condition of the urine is frequently connected with a peculiar organic lesion of the kidneys, giving occasion to dropsy, and rendering the system in general obnoxious to various other affections, chiefly of an inflammatory nature. The inquiry was soon afterwards taken up by Dr. Christian, and by the late Dr. James Gregory of Edinburgh, whose observations generally corroborated those of Dr. Bright. Subsequently the subject was investigated by Dr. Osborne of Dublin; by M. Rayer, and M. Solon, in France; by Professor M. C. Forget of Strasburgh, and by many others both in Great Britain and on the continent. The results of the earlier investigations were various; some corroborating, others rendering doubtful, the accuracy of Dr. Bright's conclusions; though the majority of those who published on the disease decided more or less in favour of Dr. Bright. More recently the subject has been carefully studied by the aid of the microscope, and much additional and most important light has been thrown on the true nature of the affection. To these discoveries we shall have occasion to allude. In the mean time I may repeat, that I do not intend to take up the question controversially; but availing myself of the experience of others, in addition to my own, shall discuss the subject as if such controversy had never existed.

In the former editions of this work, I considered the albuminous matters occurring in the urine as of two distinct kinds, viz. chylous and serous; in the first case, the albuminous matters of the urine were supposed to resemble the albuminous matters in the chyle; in the second case, the albuminous matters of the urine were supposed to be identical with the albuminous matters of the blood. I also remarked, that distinctly defined instances of both these varieties of albuminous urine are rather uncommon; and that by far the most frequent form which the disease assumes, seems to be of a mixed character; that is, the albuminous matters in the urine partake more or less of both the chylous and serous characters. To these opinions, which seem to be corroborated by recent observation, I still adhere; because I do not consider that the true pathology of this important class of affections can be explained without some such assumptions. I shall therefore consider the subject of albuminous urine generally under the heads

of *Chylo-serous urine*, and of *Serous urine*; premising only, that these two forms of disease are supposed to gradually run into each other, so that no well-marked line of distinction can be drawn between them; and that the second form of the disease is by far of the most frequent occurrence.

Of Chylo-serous Urine.

Chylo-serous urine, in the sense we here employ the term, is distinguished by its white appearance, and by its undergoing, in a greater or less degree, spontaneous coagulation. The following observations comprise a summary history of chylo-serous urine, and of the symptoms which usually accompany it; as well as of the principles to be kept in view in its treatment.

Chylo-serous urine, when first voided, is always more or less white and opaque. In different individuals, however, and even in the same individual at different times, the colour varies from a pale opalescent white, or amber, to milk-white. Both varieties of the secretion usually coagulate spontaneously. When the urine is simply opalescent, the coagulum formed is generally small and partial, and occasionally occupies the centre of the vessel as a contracted mass; like the coagulum of the blood in inflammation. When the urine is quite white and opaque, the whole coagulates into a tremulous mass like blanc mange, and assumes the shape of the vessel into which it is passed. The coagulum in both instances, particularly if removed from the vessel and placed on a flat inclined surface, gradually separates into two portions—a fluid or serous portion more or less opalescent or milky, like the urine itself, and which when left at rest for a few hours frequently throws up a creamy matter on its surface; and a very delicate fibrinous mass, small in comparison with the original bulk of the coagulated mass, of a flesh-like appearance, and generally tinged more or less of a red colour, from the presence of the colouring matter of the blood. Of these two varieties of chylo-serous urine, the first or opalescent variety occurs after long fasting; while the white and milky variety occurs soon after a full meal, as some hours after dinner. The serous portion of both varieties of urine

contains abundance of albuminous matter in various stages of development; that is, a large portion of the albuminous matter in the white variety of urine, consists of albuminous matters in a hydrated or *incipient* state, precisely as it exists in the chyle; while the albuminous matter in the urine passed after fasting is in a more developed state, or less hydrated, and approaches in its properties to the albumen of the blood. In both varieties, the principle that chiefly causes the opacity or whiteness, is an oily matter in an emulsive form; or, in the white variety, the colour may in some way be partly associated with the *incipient* or hydrated albumen. The solid portion of the coagulum is fibrine, in different states, of development or combination with water, like the albumen; while the red colouring matter is identical with the colouring matter of the blood, but in a less perfect state of development. The specific gravity of the serous portions of chylous urine varies in different instances from 1·010 to 1·020, or upwards, and it always contains urea, and the saline matters usually found in healthy urine.

The constitutional symptoms attending this peculiar condition of the urine, are less marked and severe than might be supposed. In the slighter cases, feverish symptoms are usually present; accompanied by a sense of uneasiness in the back and loins. The tongue also becomes loaded and dry, and there is in consequence more or less of thirst; a dry and unnatural state of the skin; and torpid bowels. In severe cases, the symptoms approach those of diabetes; the thirst is more oppressive; the appetite inordinate; and there is some degree of emaciation and debility. In this form of the disease also, the patient experiences difficulty in passing the urine, owing to the formation of coagula in the bladder, which block up the urethra; indeed I have seen this constitute the most troublesome symptom of the disease.

The present disease may be said to be of rare occurrence in this country; but in certain hot climates it is not unusual. Thus I have been assured, that it is by no means uncommon among the negroes in some of the West India Islands.* It is stated also by

* I am indebted for this fact to Dr. Watson, who, in 1835, introduced me to Mr. Thomas from the Island of Barbadoes, where he had resided for ten years; during which time, Mr. T. informed me that he had seen at least a dozen well-marked cases of Chylous urine in Negroes.

M. Rayer to occur frequently in Brazil. My own limited observations likewise, of which the following may be considered as a summary, corroborate the remark, that the disease is of greater frequency among the natives of hot climates.

Either in my own practice or by the favour of different friends, I have now seen more or less of fourteen cases of this affection ; and though little with respect to the complaint can be expected to be established from such a limited experience ; yet the following results may not be deemed altogether uninteresting.

First. The disease occurs in both sexes before and after puberty. Of the fourteen cases, five were males and nine females. In three cases, two males and one female, the disease occurred before puberty ; of these three cases, one was a male infant of about eighteen months old.

Secondly. Of the fourteen cases, eight occurred either in natives of hot climates, (East and West Indies,) or in individuals who had resided for many years in hot climates.*

Thirdly. The general health suffers much less than might be expected. Two of the females, for instance, while labouring under the affection in a marked degree, became pregnant and brought forth healthy children. Hence the disease does not interfere with the generative functions ; nor with the secretion or qualities of the milk.

Fourthly. Of the fourteen cases, four are known to be dead. Of the remainder, five, I believe, are alive and well. Of the others I can give no account. In two of the fatal cases, the patients were cut off by acute attacks of inflammation of the abdominal viscera. The third patient, whose case will be subsequently given as an illustration, died apparently in a state of exhaustion and great emaciation, after labouring under the affection

* The last case which occurred to me was in 1845, in a lady 68 years of age, a native of the West Indies. The complaint was first noticed about three months before I was consulted, and continued mere or less in spite of all remedies till March 1847, when, without any assignable cause, it suddenly ceased, and up to this time, October, remains absent, and she has recovered her usual appearance and health. I am indebted for a knowledge of this case to Mr. Gore of Bath, who agrees with the patient herself in thinking, that "neither diet or medicine of any kind controlled or even modified the peculiar secretion from the kidneys."

for nearly twenty years. The fourth case was that of a lady who laboured under the affection for many years, but I am unacquainted with the circumstances of her death. From these facts, as well as from the histories of the other cases, it is evident that the disease may last for a very considerable period without endangering the existence of the patient.

Fifthly. The disease is not necessarily connected with organic lesion of the kidney; at least organic lesion appreciable by the senses. In one of the fatal cases which occurred under the care of Dr. Roe, to whom I was indebted for the particulars of the case, the body was inspected, and I had an opportunity of examining the kidney, which was found to be perfectly healthy; the kidney was exhibited at my Gulston Lectures, delivered at the College of Physicians, in 1831. The patient was a young girl of about fifteen years of age; and the immediate cause of her death was, I understood, inflammation of the bowels. In another instance, I had an opportunity of examining the urine passed in the morning and after dinner, within a few weeks after the disease, in its worst form, had been apparently arrested by medical treatment; and to my surprise *I found both specimens perfectly free from albuminous matter*; and, as far as I could determine, quite natural.*

Sixthly. The causes of this affection, whether predisposing, exciting, or proximate, are imperfectly understood. If we may judge from the little that is known, we may say, that residence in a tropical climate predisposes certain individuals to the affection. The exciting cause, in one of my cases, was supposed to be the drinking of cold water while the person was warm; and in one or two of the other cases, exposure to cold seems to have had something to do with the attacks. In the early stages of the affection, a tendency to inflammatory action in the system is sometimes present; and indeed at all times, such an inflammatory state of the system seems to be easily induced. Yet it is remarkable, that in one case which I attended, and in which acute inflammation of the liver and phlogistic fever took place; the urine, during the continuance of the acute symptoms, lost entirely its chylous cha-

* The lady whose case is here alluded to—a native of the East Indies, and in whom the disease first occurred twenty-one years ago—was recently alive and in good health.

racter. The same remarkable disappearance of the chylous symptoms also subsequently occurred in the same patient, during the presence of severe ptyalism from mercury. But as soon as the inflammatory action and the mercurial excitement had ceased, the chylous condition of the urine returned, even worse than before.* The proximate cause of this affection seems to lie partly in the assimilating organs, and partly in the kidneys. The chyle, from some derangement in the processes of assimilation, is not raised to the blood standard ; and consequently being unfit for the future purposes of the economy, is, agreeably to a law of the economy, ejected through the kidneys; but these organs, instead of disorganising, or reducing it to the crystallised state as usual ; (that is, instead of changing the chyle into the lithiate of ammonia,) permit it to pass through them unchanged. That this is a just view of the matter cannot, I think, be doubted ; for if the chyle was properly converted into blood, not chyle, but blood, ought to be thrown off by the kidneys. On the other hand, it may be stated, in proof that the kidneys are likewise affected ; that I have often found chyle in the blood, when a trace of albuminous matter has not been perceptible in the urine. In a healthy condition of the kidneys, therefore, even although chyle does get into the sanguiferous system, it is not necessarily ejected as chyle ; but, in passing through the kidneys is subjected to the usual changes. The derangement of the kidneys, however, in this affection, appears to be purely functional ; otherwise the urine could not possibly recover, as it sometimes does, its healthy condition.

Treatment.—Of the treatment of this affection, very little can be satisfactorily stated. If there be obvious inflammatory symptoms present, general or local blood-letting will be proper. In the more chronic states of the affection, local counter-stimuli may be applied ; but they seldom exert much beneficial effect. Thus I have known a seton, when first inserted, seem to do good ; but the affection, even under its full operation, has soon become as bad as ever. In the more chronic conditions of the disease also, I have seen the mineral acids and astringents, as alum, the acetate of lead, &c., arrest the affection for a while ; though

* In these instances, the disappearance of the chyle from the urine may be doubtless ascribed, in some degree, to the small quantity of chyle formed during the presence of the inflammatory attack, and the ptyalism.

it has soon returned. The same is true of opium; which sometimes causes a temporary suspension of the symptoms. On the other hand, the disease occasionally disappears of its own accord for years; and then again recurs, without any apparent cause; of which circumstance one or two instances have come to my knowledge.

The following interesting case was given in the former editions of this work, and I now repeat it, with the sequel. The patient was a married woman, about thirty years of age. The disease first made its appearance in 1817, and proceeded gradually. Her appetite was greater than natural, and she had some other symptoms of diabetes; but her general health seemed very little affected; and almost the only inconvenience of which she complained, was the difficulty of passing her water, owing to the coagula which formed in the bladder, blocking up the urethra.

November, 1818, I received three specimens of this woman's urine, namely, one voided in the morning; another a little after breakfast; and a third in the evening.

The first specimen voided in the morning, consisted of a solid jelly-like mass, or coagulum, of a pale amber colour. This coagulum was of an extremely delicate texture; and on being submitted to a gentle pressure, or even allowed to drain, parted with a large proportion of a serous fluid of the colour above mentioned, and at the same time became exceedingly reduced in bulk, and assumed the appearance of a red fleshy-like mass of a fibrous texture; which on examination was found to have all the properties of the fibrine of the blood, mixed with a few of the red particles of the same fluid. The specific gravity of the serous portion was 1·019. Its smell was very faintly urinous; it did not affect litmus or turmeric papers; and though it contained a large proportion of albuminous matter coagulable by heat; it yielded distinct traces of the presence of urea.

The second specimen, voided after breakfast, resembled the first in its general character; but differed from it in some minor particulars. Thus, the serum was more of a whey colour; the fibrous coagulum was less, but more compact and firm; and held entangled in its texture, a large proportion of the red particles of the blood. The specific gravity of the serum of this specimen was only 1·0124; and it contained a considerable proportion of albu-

minous matter, not coagulable by heat. It contained also a sensible portion of urea.

The third specimen, voided in the evening, after an early dinner taken about noon, was the most remarkable, and so closely resembled chyle in all respects, that I am doubtful, if it had been brought to me as a specimen of that fluid, whether I should have discovered the imposition. It consisted of a solid coagulum of a white colour, and assuming the shape of the vessel like blanc mange. On being submitted to a gentle pressure and permitted to drain, the residual solid portion was, like that of the others, small in quantity, but whiter than the coagula of the other specimens. It was, however, intermixed with strings of a firmer consistence, and of a red colour. The serous portion was white and opake like milk; and on being heated and permitted to stand at rest for some time, threw up a substance on its surface very like the cream of milk, and which, like cream, was found to contain a considerable proportion of a butyraceous or oily principle. Its specific gravity was 1·0175; and its smell was not urinous, until it had been concentrated by evaporation, when it became slightly urinous; and in this concentrated state, it yielded faint, though distinct traces of the presence of urea. It was not coagulable by heat, though it contained abundance of albuminous matter, chiefly, however, in that state in which it exists in chyle; and which I have denominated *incipient* or hydrated albumen. One hundred grains of this serous fluid evaporated to dryness, left about seven grains; half a grain of which only was soluble in alcohol, and consisted of urea, a little fatty matter, and the other principles commonly found in all animal fluids; while the remaining six grains and a half consisted chiefly of the imperfect albuminous and fatty principles above mentioned; with some salts. This residuum burnt with a flame; yielded an odour somewhat like that of cheese; and left a coal difficult to incinerate; but which when burnt was found to contain a considerable proportion of earthy salts, consisting chiefly of the phosphate of lime.

I had an opportunity of examining this woman's urine after fasting twenty-four hours. The coagulum was now much smaller in bulk, and seemed to contain more red particles. The serous portion was nearly transparent, and possessed in a considerable

degree the colour and other sensible properties of urine. Its specific gravity was 1·021; and it was found to contain abundance of urea, and a large proportion of more perfect albuminous matter than either of the other specimens.

The above remarkable case occurred to my friend Dr. Elliotson, to whom I was indebted for the opportunity of examining the urine. From particular circumstances, no plan of medical treatment was adopted: and Dr. E. lost sight of her, till November 1822; a period of four years. At this time she appeared in good health; but informed him that the urine had remained in precisely the same state ever since he had last seen her, and still continued so; and that in the interim she had become pregnant, and borne a living child. I subsequently learnt from Dr. Elliotson, that this woman continued to suffer from the affection till 1836; when she died emaciated, after labouring under the disease for nearly twenty years.

In the present state of our knowledge it has been deemed proper to treat of Chylous urine separately, chiefly for the reasons stated; but I have little doubt that the affection hereafter will be found to constitute a mere variety of one of the following forms of Serous urine.

Of Serous Urine.

Under this head are included the greater number of the diseases which, since the publication of Dr. Bright's medical reports, have attracted so much notice. Strictly speaking, perhaps there are many varieties of disease belonging to this head, differing in degree, and even in kind, from each other; but as in the present state of our acquaintance with these subjects, such varieties can with difficulty be distinguished; and as the distinguishing of them would perhaps lead to no practical utility; I shall briefly consider the diseases connected with a *serous* condition of the urine as of two principal kinds or *species* only, each further varied by the accidental circumstances of *quiescence* and of *inflammation*. Hence our subject may be thus presented:

Species a. *Serous Urine; the Kidney in a } var. 1 Quiescent.*
STATE OF APPARENT HEALTH. } var. 2 Inflamed.

Species b. *Serous Urine; the Kidney in a } var. 1 Quiescent.*
STATE OF DEGENERATION. } var. 2 Inflamed.

Species a. var. 1.—*Of Serous Urine; the Kidney in a STATE
OF APPARENT HEALTH; Quiescent.*

In a perfectly healthy condition of the kidneys, both functional and organic, perhaps it may be stated, that albuminous matter is never found in the urine. When, therefore, albuminous matter is found in the urine, we may always safely conclude that some alteration from the normal condition of the kidneys is denoted. The question is, what is the nature of this aberration? In reply to this question, it is generally admitted that certain organic derangements of the kidneys give occasion to scrous urine; and the only point to be considered here is,—do mere functional derangements of the kidneys give occasion to serous urine?

In the Third PART of this volume, I have attempted to show that a distinct function of the kidney, which I have named the *disorganising function*, exists; and that by means of this function, the kidneys are not only enabled to separate from the system inorganised and crystallisable matters already existing in the blood; but are also enabled to disorganise (i. e. to reduce to a crystallisable condition) other matters existing in the blood, which the welfare of the economy requires should be removed from the sanguiferous system. Now, if we suppose this disorganising function of the kidneys to be *temporarily suspended*; the albuminous matters of the blood, which, in passing through the healthy kidneys, would have been converted into the lithate of ammonia, &c., will pass through these organs without suffering any change, and consequently appear as albuminous matters in the urine; just as the chyle, under similar circumstances, was supposed, in a former paragraph, to pass through the kidneys unchanged.—Whether such a state of simple suspension of the functions of the kidneys ever takes place alone, without involving other parts of the system, I am unable to decide; but my belief at present is, that it does not; and that in all such instances, as for example that of chylous urine just alluded to, not only a condition of the kidneys exists, to which, for want of a better name, I must apply the epi-

that *inflammatory*; but that other parts of the system (especially those connected with the assimilating functions) are likewise more or less involved in a similar condition; and that when this supposed inflammatory condition of these organs subsides, the kidneys resume, more or less perfectly, their natural disorganising function; and the albuminous matter, as a consequence, disappears from the urine. This peculiar condition of the system and temporary suspension of the nephritic function may be apparently produced by various causes; among which may be mentioned the effects of certain drugs, as mercury, cantharides, &c. A similar condition of the system seems also to be occasionally produced by, or rather to follow, attacks of fever: also by a state of pregnancy, by certain indigestible articles of food; by violent mental emotions, &c.; under the operation of all which, as well as of many other similar causes, the urine has been found to be temporarily albuminous. There is a point, however, of great importance connected with this inquiry, to which I particularly wish to draw the attention of the reader, viz. that the causes mentioned do not *invariably* produce serous urine in all individuals; the inference, therefore, must be, that in the persons liable to be so affected, there exists a sort of latent predisposition (incipient degeneration?) to kidney disorders; otherwise every individual ought to be similarly affected by the operation of the same causes; which, as just stated, is not, according to my observation, the case. From what has been stated then, the answer to the query above proposed will be,—that in some individuals, the urine is liable to become albuminous from certain derangements of the system in general, and of the kidney in particular, which cannot at present be otherwise defined than as *functional* derangements; though it is not improbable, that such assumed functional derangements may partake of the character of incipient disease of the kidneys.

Species a. Var. 2.—Of Serous Urine; the Kidney in a STATE OF APPARENT HEALTH; Inflamed.

The serous urine accompanied by acute inflammation of the healthy kidney, is generally transparent, or nearly so, when passed, but occasionally becomes opaque and turbid on cooling. Its colour is usually much deeper than natural, and its specific gravity varies from 1.018 to 1.030, or more. For the most part, also, the quan-

tity of urine passed by the patient in a given time, notwithstanding the frequent calls, is far below the healthy standard. At the outset of the most acute instances of the disease, the urine is sometimes without sediment; and, in a few rare instances, mixed with blood. The sediment deposited by acute serous urine, is usually of a deep brownish red colour; and consists essentially of the lithate of ammonia. In all instances on the application of heat (about 150° or 160°) acute serous urine becomes opaque, from the deposition of albuminous matter.

The constitutional symptoms accompanying acute serous urine are of a very formidable kind; and are always associated with a great tendency to anasarca *cœdema*, and serous inflammation. This form of anasarca has been long distinguished by the name of *inflammatory dropsy*; and though it had been obscurely alluded to by preceding writers, may be said to have been first brought into general notice among English physicians, by the works of Dr. Wells and Dr. Blackall. Inflammatory dropsy usually comes on rather suddenly, and is preceded by chilliness and rigors, which are speedily followed by the well-known train of feverish accompaniments, viz. a full and hard pulse; heat, dryness, and soreness of the skin; a state of anxious restlessness; and oppressive drowsy headache. The scanty and high-coloured urine above described is very frequently passed in small quantities at a time; and occasionally with more or less of irritation. There is a dull heavy pain in the loins, increased by pressure; and sometimes extending to the whole of the lower region of the abdomen; particularly to the groins. With these symptoms the stomach sympathizes; and there is almost always nausea, and sometimes vomiting; and pressure over the region of the stomach produces distressing uneasiness, or actual pain. After a few hours, or at most, a day or two, the face and extremities begin to swell; and by degrees the *cœdema* extends, more or less, over the whole body. The urine is now still further diminished in quantity; the drowsiness increases; and at length the patient becomes quite comatose; in which state, if active measures have not been taken in time, he usually expires; sometimes in convulsions. In other instances, serous effusion, accompanied by high inflammatory action, takes place into the chest or other cavities. This is attended by dyspnoea, &c., according as the chest, or other cavity, is

affected ; and, after the most acute suffering, the patient rapidly sinks under the consequences ; or, at the utmost, survives only to be miserable.

This peculiar and acute form of disease may probably happen at all ages, and under all circumstances, from exposure to the requisite exciting causes. A degenerated condition of the kidneys undoubtedly predisposes to the affection ; but, as far as my own observation extends, (which seems to agree with the observation of others,) this form of disease occurs most frequently in young and robust subjects in whom no such predisposition could be ascertained to exist, from exposure, under certain circumstances, to the combined effects of cold and moisture. Thus several instances have occurred to me, in which the patients, while in a state of intoxication, had slept for some hours on the wet ground in the open air during severe cold. Other causes mentioned by authors are, the drinking of cold fluids while heated ; the sudden repulsion of erysipelas ; of the acute exanthemata ; of an habitual diarrhoea, &c. The proximate or immediate cause of the disease seems to consist in an inflammatory condition of the system generally, but involving the kidneys in particular.*

The prognosis in this formidable disease, as above mentioned, is generally unfavourable. A large proportion of the cases terminate fatally, from the immediate consequences of the affection ; and those who survive generally die, sooner or later, with all the symptoms of degeneration of the kidneys, and serous urine in their worst forms, to be presently described.

Nearly allied to the above state of disease is the *anasarca*, which frequently follows *scarlatina*, and more rarely the measles, urticaria, and some other diseases particularly affecting the skin. In *scarlatina*, this form of dropsy usually comes on after the fever has begun to subside ; that is to say, between two and four weeks after the first commencement of the eruptive fever. The appearance of the swelling is commonly preceded or accompanied by an increase of feverish symptoms, particularly towards night ; the bowels

* For an account of the microscopic phenomena presented by the urinary sediments in this and other forms of disease, accompanied by serous urine, the reader is referred to the conclusion of this section.

having continued costive, the urine scanty, and the skin harsh and dry. At this period, also, frequent vomiting occasionally occurs. In a short time the face, and particularly the eyelids, begin to swell, and this swelling extends more or less rapidly over the whole body. As the swelling increases, the patient usually becomes more torpid and drowsy; and, in some cases, symptoms indicative of effusion on the brain, or into the cavities of the pleura or peritoneum, take place. The urine now becomes still more scanty and high-coloured, is often turbid, and generally passed at short intervals, in very small quantities at a time, with more or less of pain. The colour of the urine is occasionally brown, or is quite red; and in this case the colour obviously depends on the colouring matter of the blood. In almost all instances, however, whether it contains the colouring matter of the blood or not, the urine coagulates by heat, showing that it contains albuminous matter in solution.

The exciting cause of this anasarcaous affection has been supposed by some to depend, like the preceding, on exposure to cold and moisture; but, in many instances, it cannot be referred to this, or to any other satisfactory cause. The immediate cause seems to consist in an inflammatory state of the whole system, involving the kidneys in particular. The affection, to whatever cause it is to be ascribed, occurs much more frequently in children than in adults; and it is usually so much the more severe, as the preceding eruptive fever and sore-throat have been mild and favourable.

With respect to the treatment of inflammatory anasarca, accompanied by inflammation of the kidney, it may be observed generally, that active antiphlogistic measures are absolutely necessary. Blood-letting, general and local, must be resorted to according to circumstances, and particularly according to the period, degree, and seat of the inflammatory action. If the patient be a young and robust individual, of sound constitution, blood-letting from the arm, and cupping over the loins, may be usually repeated with excellent effect. If the patient be a person of previously dissolute habits and of broken constitution, with probably unsound viscera, general blood-letting must be applied with greater caution, and cupping and leeches will be more appropriate. Much may be learned on this point by a careful inspec-

tion of the blood first drawn. If the blood be dense, and abounding in colouring matter, blood-letting in general may be safely repeated; if, on the contrary, the colouring matter be obviously deficient, and the blood be poor and watery, further depletion will hardly be proper. Another class of remedies to be resorted to, after, or in conjunction with, depletion, and which has been particularly recommended in this affection, is diaphoretics. Of these, perhaps, the Dover's powder is the most efficient; with which may be conjoined the use of the warm bath, or, what is better in some instances, of the vapour or hot air bath.¹ The patient, also, in the intervals, should be most carefully protected from the influence of cold by warm clothing; and particularly by flannel next the skin. Other diaphoretics, as the various antimonials, the acetate of ammonia, &c., may be also occasionally resorted to with advantage. Calomel is a doubtful remedy; but in some instances may be advantageously combined with Dover's powder, &c. Stimulating diuretics act unfavourably; particularly in the early stages of the affection. When the active symptoms of the complaint have been subdued by blood-letting; and the urine, as is generally the case, from the employment of this active remedy, has become improved in quality and increased in quantity; the more gentle diuretics may be often resorted to with advantage; such are the acetate, citrate, or nitrate of potash, with the *spir. aetheris nitrici*, &c. The bowels should be kept open, and occasionally a brisk purgative may be given; but there seems to be no good attainable by constant purgatives; which may, in those instances in which the kidneys are severely affected, lead to that harassing diarrhoea too commonly proving fatal in this class of diseases. When the patient, by these and other appropriate means, has been fortunate enough to recover from the immediate attack, it will be absolutely necessary for him, for a long time, perhaps during the remainder of his life, to consider himself as an invalid; to live abstemiously and carefully; to take regular and moderate exercise; and, above all things, to avoid exposure to cold and wet. Indeed, if his circumstances admit, he may advantageously spend the winter months in a warmer climate.

The treatment of the anasarca occurring after scarlatina, &c., resembles in principle the treatment of the acute form of inflammatory dropsy above described. If there be urgent symptoms of

inflammation, or of congestion, cupping or leeches, near the part affected, should be resorted to ; and these means may be followed by the application of blisters, or other appropriate counter-stimuli. If the head be particularly affected, active depletion and cathartics will be proper. The diarrhœa which occasionally supervenes should be moderated, but not suddenly checked. If this diarrhœa, as is sometimes the case, appears to depend on an inflammatory condition of the mucous membrane of the intestines, recourse may be had to leeches, followed by fomentations, &c., to the abdomen. If the diarrhœa be the immediate effect of the irritation occasioned by faecal accumulation, mild and efficient purgatives, as castor oil, &c., should be administered, so as to completely get rid of the offending cause. The warm bath, both as a means of prevention and of cure, may be advantageously had recourse to in this affection, and the patient should be kept in a warm and uniform temperature, so as to promote a free action of the skin. When the more acute symptoms have subsided, diuretics may be usually employed with good effect ; such as digitalis conjoined with the syrup of squills, the acetate of potash, ammonia, &c., according to the circumstances of the case ; and on the complete cessation of active symptoms, the citrate of iron may be often advantageously added to the citrate of ammonia, or other diaphoretics employed. During and long after convalescence the effects of cold must be particularly guarded against.

The consideration of the two preceding forms of disease scarcely falls within our present design. I have been induced to give the above sketch of their history, with the view of pointing out their connexion and analogy with the chronic forms of serous urine, to be next considered ; many cases of which I have been distinctly able to trace to acute attacks upon the kidney, similar to those first described ; as well as to the analogous attacks following scarlet fever. In those cases originating in attacks of scarlet fever, the anasarcaous symptoms following that disease have been usually severe, and in some instances treated by large and active doses of calomel ; which, no doubt, contributed its share towards the production of the chronic forms of the disease.

Species b. var. 1.—*Of Serous Urine; the Kidney in a STATE OF DEGENERATION.*

Before we proceed to consider this important group of diseases, it will be necessary to make a few remarks explanatory of the sense in which we employ certain terms in common use; as well as the principles of our arrangement.

Organic diseases may be supposed to arise from two separate, but frequently co-operating causes, which, for the sake of distinction, we may term *degeneration* and *inflammation*. By degeneration is understood those slow and indefinable changes occurring in all living structures, which appear to be connected with, or to result from, the gradual decay of the vital processes in general, and particularly of the processes of assimilation. Degeneration, therefore, is the natural and universal consequence of age; but it may arise in early life from a variety of causes, among which the most frequent are; first, an *inherited* and *innate* weakness of the vital powers, either as they exist in the system generally, or as they exist in particular organs; as, for instance, in the *kidneys*: secondly, an *acquired* weakness of the vital powers in general, or as regards the vital powers of particular organs produced by a variety of slowly acting causes; such as long-continued errors in eating and drinking; long exposure to the influence of unhealthy situations; or of occupations unfavourable to the general health, &c.: and thirdly; an *acquired* weakness of the vital powers, either general or local, produced by the operation of acute causes; as acute inflammation, severe accidents, &c.

The term *inflammation* is employed in its admitted sense, but as consisting of three kinds or grades, viz., *acute inflammation*, or inflammation in its most active form; such as it more especially exists in healthy subjects and in healthy structures: *chronic inflammation*, or that obscure state of activity, which, for want of a better term, we designate inflammation, and which is almost exclusively limited to degenerated structures: and *congestive* or *adynamic inflammation*, such as occasionally follows acute inflammation in healthy subjects; but much more generally takes place in unhealthy subjects; or succeeds to the chronic inflammation of degenerated structures.

Having thus defined the senses in which we employ the terms

degeneration and *inflammation*, we shall briefly state our reasons for adopting these peculiar views of the subject.

Many of the continental writers, and particularly those of France, appear to consider inflammation as almost the only cause of organic disease; at least it is difficult to arrive at any other conclusion, provided they employ the suffix *itis* in its usual acceptation. Thus, in the excellent work of M. Rayer, the diseases to be here and elsewhere considered, are arranged under the heads of *Nephritis*, *Pyelitis*, *Peri-nephritis*, &c., according as the secreting portion of the 'kidney, or the membrane lining its internal cavities, or covering its external surface, &c., is found after death to be affected with signs of recent inflammation. Now to me this view of the subject has always appeared unsatisfactory. That *inflammation* is the *immediate* cause of death in most of these diseases is not denied; but granting this, does the term inflammation, even when qualified by the epithet *chronic*, or otherwise, rightly designate that comparatively quiescent state of the kidneys, which immediately preceded the fatal inflammatory attack? In other words, cannot the deranged structure and obliteration of an organ by foreign deposites take place, or at least, having taken place, exist, independently of inflammation? and are not the presence of such morbid deposites in the intimate structure of an organ sufficient to account for its functional derangements? That there is such a condition as chronic inflammation, and that such a state of chronic inflammation does, in some instances, exist in the kidneys, previously to the more acute and fatal attack, is not doubted; but my decided opinions are, that in a large number of cases the previous quiescent state of the kidneys cannot, by any justifiable latitudinarianism, be designated by the term *chronic inflammation*; that the epithet *structural degeneration* more aptly expresses the condition of these organs; and finally, that this structural degeneration and the peculiar condition of the system which originally produced, and is now in turn aggravated by it, are quite sufficient to account for all the morbid phenomena of a purely chronic character.

If these views be admitted, we may deduce from them the following inferences:

First. A degenerated condition of an organ, from whatever cause produced, may exist for a greater or less period in a state

of comparative quiescence; during which state of quiescence, the system in general may accommodate itself more or less perfectly to the degenerated state of the organ.

Secondly. Local degenerations are liable to become aggravated from a variety of causes, and particularly from inflammation; and when such causes have ceased to operate, as, for instance, when the inflammation has subsided, the general system, as before, gradually accommodates itself, during the succeeding period of quiescence, to the new order of things induced by the inflammatory attack.

Thirdly. Such alternations of comparative quiescence and of activity repeatedly take place; the degeneration on the whole being increased during each successive paroxysm; till finally the patient is cut off during an inflammatory attack, which overwhelms his exhausted powers.

Fourthly. The patient in these cases cannot be said to die from inflammation alone; but from the conjoint effects of degeneration and of inflammation. Moreover, the inflammation would probably never have taken place, had degeneration not existed as a predisposing cause; or having taken place in a perfectly healthy structure, the inflammation would not have proved fatal.

Fifthly. The appearances presented after death under those circumstances are often very unsatisfactory, and quite useless in a pathological point of view; inasmuch as by presenting the conjoint effects of degeneration and of inflammation, they do not enable us to distinguish what is due to degeneration and what to inflammation; a distinction in all instances of the utmost practical importance.

These inferences are not given as novelties, but as offering a brief sketch of the grounds on which, in my opinion, pathological investigations ought to be made. They have been probably again and again pointed out by pathologists, yet I do not remember to have seen them anywhere stated *totidem verbis*. I confess, however, that my reading on such subjects has been limited; chiefly because I have found these, and other important distinctions, too often neglected by authors; and because, in consequence, their works have presented a confused and unphilosophical jumble, from which no practical inference could be safely deduced.

Taking for granted, then, that inflammation is not the *sole* cause of disorganization, let us briefly inquire into the general nature of the processes which we have classed together under the term *degeneration*, or *degenerating* processes.

The degenerating operations terminating in the disorganisation of living structures are very numerous; but for all *practical* purposes (at least as far as we are at present concerned) they may be classed under two general heads or divisions, viz. degenerating processes connected with, or resulting from, *anæmotrophy*; and degenerating processes connected with, or resulting from, *haemotrophy*. By the terms *anæmotrophy* and *haemotrophy* it need scarcely be mentioned, that we intend to convey the notions of a deficiency, and of an excess of *sanguineous nourishment*; which deficiency and excess of sanguineous nourishment may be supposed to depend either on the expansion and contraction, or on the greater or less number, of the blood-vessels supplying the degenerated organs; or on the richness and poverty (i e. on the profusion or comparative absence of the *red* particles) of the blood; or on both of these causes variously associated.*

Of all the general causes predisposing to the *anæmotrophy* or *haemotrophy* of organs, those alone arising from age are *necessarily* active. The *age of the patient* therefore constitutes a *natural boundary* or *landmark* among the phenomena of deg-

* As stated in the text, the terms *anæmotrophy* and *haemotrophy* simply imply a *deficiency* and an *excess of sanguineous nourishment*. *Atrophy* and *hypertrophy*, as commonly understood, include the idea of diminished and increased *magnitude*; and do not, therefore, exactly express the meaning intended to be conveyed. On the other hand, *anaemia* and *hyperæmia* have reference only to the *quantity* of blood present, without regard to its nutritive qualities. For these reasons, as well as for the sake of distinction, I have adopted the terms mentioned to designate those peculiar conditions of degenerated organs apparently arising from deficient or excessive nourishment by (red) blood. That some such distinction is requisite for describing the condition of degenerated structures is evident from the fact, that an organ may be *anæmotrophied* or *haemotrophied* without being diminished or increased in bulk; or without the presence of general *anaemia* or *hyperæmia*; and *vice versa*. It may be proper also to remark, that in all instances of *anæmotrophy* and *haemotrophy*, the nourishment of textures is probably not only deficient in *degree*, but in *kind (cacotrophy)*; but as, in the present state of our knowledge, we are ignorant of the nature of such derangements, we have limited our inquiries to derangements of *degree only*.

neration, and particularly among the phenomena of nephritic diseases. Before the age of forty there is no natural reason why the kidneys in a perfectly healthy individual, who has lived regularly, should in any degree or mode suffer degeneration. But about the age of forty, many causes often co-operate with the natural tendency to degeneration which then begins to take place, and thus to induce or accelerate a change in the condition of organs, and particularly of the kidneys. Among such causes may be mentioned the existence of long-continued habits unfavourable to health, but sanctioned by the usages of society; as the daily use of a full and stimulating diet; the free use of wine, &c. Of all other causes, however, particularly in large towns, venereal affections and their remedies lay the foundation of kidney diseases in every class of society, and perhaps at all ages, more frequently than any other cause. Few in early life so situated escape these loathsome affections in some form or other; and what with the excitement of fermented liquors, and, among the lower classes, the constant use of ardent spirits, the wonder is, not that the urinary organs suffer, but that they do not suffer even more severely than at present. And even if the effects of youthful excesses sometimes subside, as they do for the time, they are often felt when the vital powers become enfeebled in advanced life, and thus contribute to render old age miserable. Hence the gay and thoughtless little think of the consequences of their dissipation, and that they are in fact, to use a mercantile simile, drawing bills at twenty, which will certainly be demanded at some future period of their lives with fearful interest.

Among the other causes predisposing to affections of the urinary organs in general, and to kidney affections in particular, is the often-mentioned inherited tendency. I do not mean to assert that the children of parents subject to these affections *invariably* suffer; but I have seen repeated instances in which they *have* suffered from urinary disorders, at an age, and from exciting causes under which a perfectly healthy individual would probably have escaped with impunity. Another of the most fertile of the causes predisposing to urinary diseases at all ages, but particularly in early life, is the *strumous* diathesis. When any cause, whether of a predisposing or exciting character, co-operates with the *strumous* tendency, its effects in general are much

more decidedly marked and obstinate. Lastly, affections of the urinary organs are often complicated with a gouty or rheumatic predisposition, especially after the age of forty; and in the treatment of such complications the prevalent tendency must be kept in view.

From these and a variety of other causes, either predisposing or exciting, it too often happens that in early life, and very frequently in later life, symptoms of degeneration of the kidneys, accompanied by a corresponding derangement of the urinary secretion, begin to be manifested. Of these derangements of the urinary secretion the presence in the urine of albuminous matter is one of the most striking, probably for the reasons formerly assigned for an analogous phenomenon; viz. the suspension or partial destruction of that peculiar function of the kidney, by which, in its healthy state, albuminous matters become disorganized; in other words, by which albuminous matters are converted into the lithate of ammonia, and the other ingredients of healthy urine.

The general inferences deducible from these remarks are,—first, that when diseases of the kidneys occur *before* the age of forty, they may almost always be considered as resulting from an inherited predisposition; or from a strumous diathesis; or as acquired in some way *de novo*. And, secondly, that when they occur for the first time *after* forty, they are generally referable to the natural decay of the vital powers incidental to age, accelerated and aggravated in most cases by long-continued habits unfavourable to health, and inducing gout, &c. In other words, premature disease and consequent imperfect assimilation are usually connected with *anæmotrophy*; whilst the diseases of middle life are frequently the result of an habitual stimulating regimen, producing plethora and *hæmotrophy*.

The properties of the urine in the diseases of *anæmotrophy* and *hæmotrophy* accord generally with the preceding inferences. Thus in the simple *anæmotrophy* of early life, the urine is usually pale coloured, of moderate specific gravity, and rather copious; while in the simple *hæmotrophy* of middle and advanced life, the urine is generally deeper coloured, of higher specific gravity, and less copious.

With regard to the general relations of *anæmotrophy* and

hæmotrophy, it may be remarked—that hæmotrophy may be supposed to pass into anæmotrophy, but that anæmotrophy can hardly be supposed to pass into hæmotrophy. Moreover, when hæmotrophy occurs in early life, and anæmotrophy in middle and advanced life, they are seldom absolutely identical with the hæmotrophy of middle and advanced life, and the anæmotrophy of early life; because in the hæmotrophy of early life, and the anæmotrophy of advanced life, the kidneys have usually become already visibly disorganised. So as regards the properties of the urine; this secretion in the early hæmotrophied kidney is often deep coloured, of high specific gravity, and deficient in quantity; but as the early hæmotrophied kidney is usually more or less disorganised, the other properties of the urine become likewise deranged; and the practised eye will readily discriminate by the presence of such derangements between the urine of the disorganised hæmotrophied kidney, and the urine of the simple hæmotrophied kidney. In like manner, the anæmotrophied kidney of middle and advanced age is almost always disorganised; and as the urine suffers a corresponding change, it may by such changes in most instances be distinguished from the urine secreted by the simple anæmotrophied kidney.

From the preceding remarks, then, it may be concluded—that, in the present state of our knowledge, the diseases connected with a degenerated condition of the kidneys and serous urine may be comprised under the two great DIVISIONS of *diseases of anæmotrophy*, and *diseases of hæmotrophy*; that the diseases of hæmotrophy occasionally pass into the diseases of anæmotrophy, but never the reverse; and, finally, that both the anæmotrophied and hæmotrophied conditions of the kidney are exceedingly prone to inflammatory excitements of a peculiar character, which modify and accelerate the degenerating processes, and ultimately prove fatal.

These inferences we consider of so much *practical* importance, that we shall make them the basis of our arrangement of chronic renal affections connected with serous urine. In conformity, therefore, with this plan, we shall separately consider in their *chronic* or *quiescent* state, and afterwards in their *acute* or *inflamed* state, the different affections connected with these two great divisions of renal disease.

DIVISION I.

*Of Serous Urine; Kidney in a state of Anæmotrophy.
Quiescent.*

The important diseases to be now considered comprise a large portion of those nephritic affections which have of late so much occupied the attention of the medical world; and which are characterised by a serous condition of the urine. They are distinguished by *anæmotrophy* natural or produced, not only of the kidneys, but for the most part of the whole system; and by their prevalence before or about the middle period of life. They exist under a great variety of forms; but for all *practical* purposes, in the present state of our knowledge at least, they may be considered together,—first, with reference, *a.* to their *incipient stage*; and, secondly, with reference, *b.* to their *confirmed stage*; under which denominations we shall briefly describe them.

a. Incipient stage of anæmotrophic affections, as marked by the condition of the urine and general symptoms.—In the earlier stages of anæmotrophy, the derangements of the kidney appear to be chiefly of a functional character; this is inferred from various circumstances, but principally from the fact that the characteristic serous property of the urine is not *always* present. Hence the cause of this peculiar condition of the secretion, whatever it may be, cannot be always active; as we might suppose it to be were it of a decidedly organic character.

State of the urine.—The precise commencement of anæmotrophy is rarely known; as it usually commences imperceptibly, and creeps on by imperceptible degrees. A tendency to the affection, as well as its incipient stages, are generally marked by a capricious and uncertain action of the kidneys; so that from no assignable cause, or from such slight causes as would not affect a person in health, the urine exhibits the following phenomena:

The colour of the urine is paler than natural, occasionally deeper; and frequently it is *acid*, even in a greater degree than in health; and in this case there is often deposited on cooling, especially after meals, a pale coloured, or occasionally a bright pink coloured sediment of lithate of ammonia. At other times the urine is nearly neutral, and becomes turbid on the application

of heat, from the deposition of the earthy phosphates. Sometimes it is *alkalescent* when passed, particularly if alkalies have been injudiciously administered ; and generally from the great susceptibility of the system, and especially of the kidneys, the qualities of the urine are liable to be changed in this affection by almost everything taken in the shape of food or medicine ; hence the sensible qualities of such articles may be more speedily and decidedly detected in this secretion than in the urine of a healthy individual ; and hence also, from this great susceptibility of change, the urine is sometimes *serous*. The quantity of the urine partakes of the same variable characters as the qualities. When the urine is high coloured and acid, it is usually scanty and of great specific gravity. When the quantity is copious, as is often the case, particularly during the latter part of the night and morning, the specific gravity is *below* the natural standard. Generally speaking, the quantity passed in a given time is above the average ; while the specific gravity is sometimes below, but frequently above the average standard of health.

Constitutional symptoms.—The constitutional symptoms accompanying the incipient stages of kidney degeneration in early life are usually marked by three prominent features ; viz., derangement of the assimilating organs ; susceptibility to cold and moisture ; and *malaise* with more or less of debility. The stomach is easily nauseated, or becomes acscent or flatulent. The appetite is usually capricious and morbid ; the bowels sluggish, or alternately sluggish and irritable. The biliary secretion is modified in its qualities, and either deficient or excessive, &c. The skin is generally dry and harsh, sometimes unnaturally relaxed ; and the patient is so susceptible of the influence of cold and moisture, that on the slightest exposure he is apt to get catarrh and bronchial irritation. To these derangements and tendencies there are almost always superadded a sense of general *malaise* and nervous susceptibility, inclining generally on the side of despondency ; a pale and haggard expression of countenance ; and often emaciation and debility.

Such are the derangements of the urine and state of health which usually precede or accompany the incipient stages of kidney degeneration in early life ; and of these and many similar derangements the kidney degeneration has been usually considered as the

mere effect. The truth is, however, that the constitutional and local affections form a closely connected group, depending alike in most instances on the same cause ; and that it is in consequence difficult or impossible to say, that the one set of derangements produces or is derived from the other.

b. Confirmed stages of anæmotrophic affections, as marked by the condition of the urine and general symptoms.—Much of what has been just stated respecting the conditions of the urine in the incipient stages of kidney anæmotrophy is equally applicable to the earlier stages of the actually disorganised kidney. When the kidney, however, has become disorganised, not only are the urinary symptoms more strikingly marked, but as the disease proceeds they assume the following forms :

In the earlier stages of the confirmed disease, the *colour* of the urine is either ordinary or paler than natural ; rarely deeper. It is generally *acid* ; in a few rare cases *alkalescent*, or speedily becoming so. In the perfectly simple form of the disease, the urine is not only transparent when passed, but remains so on cooling ;* the deposition of the lithate of ammonia being rare. On the application of heat and nitric acid, it *always* becomes turbid ; the secretion, therefore, is *permanently* serous. In the earlier stages, the *quantity* of the urine differs but little from that of health ; though perhaps, on the whole, the quantity is *above*, rather than below, the natural standard. Nearly the same remarks apply to the *specific gravity* ; which in the earlier stages does not differ much from the healthy standard ; though in general, perhaps, it will be found rather below the average. These observations, however, are subject to some variety ; as the quantities and qualities of the urine usually partake of the capricious character of the

* There is a variety of the present disease of rather frequent occurrence, in which the urine is not only passed, but remains turbid. This turbidity does not depend on the lithate of ammonia nor the phosphates ; but on a peculiar diseased secretion from the mucous membrane lining the cavities of the kidney and bladder. This form of the disease is usually induced by gonorrhœa, or by some other affection of the mucous membrane ; which either originally, or as it proceeds, becomes complicated with the granular disease of the kidney. In this variety of the disease, the patient commonly suffers exceedingly from irritation of the bladder, in addition to the other symptoms. See the subject of *Irritable bladder* in the second Book.

incipient stages of the affection. As the disease advances, the properties of the urine frequently undergo remarkable changes; and in the fully formed and latter stages of the affection the following, with occasional modifications, may be said to be the leading characters of this secretion :

The colour of the urine is almost uniformly paler than in health, and sometimes it is nearly devoid of colour altogether. Generally speaking, it retains its acid character; and though, as before, an alkaline condition of the secretion occurs, this is unusual. Its transparency is *never* affected on cooling by the deposition of the lithate of ammonia. Heat and nitric acid always produce turbidity; though the absolute quantity of albuminous matter present, is much less than in the preceding stages; and sometimes is very trifling. The *quantity* of the urine is rarely below, often as much as three, or four times above, the average standard; and in such cases the specific gravity descends to 1·010, or even to 1·008 or 1·006; and in a few rare cases, I have found the specific gravity as low as 1·001, or 1·002; or barely above the specific gravity of spring water. In such instances the quantity has been usually much above the natural standard. From the above properties of the urine it will be naturally inferred, that the positive and relative proportions of its ingredients are much diminished; and this, on examination will be found to be the case. Thus, even in the earlier stages, when the specific gravity is not remarkably low, and the albuminous matter is abundant, it will be found on the separation of the albumen by heat, that the specific gravity is often reduced four, or even as much as seven units. Hence, if the quantity of the urine be taken into account, the absolute weight of the other solid ingredients passed in twenty-four hours, is very deficient. In the latter stages this deficiency is still more remarkable; so that the proportion of solid ingredients voided in a given time, sinks to a fifth (even to one-twelfth) of the healthy average.* With respect to the *relative* proportions of the ingredients, according to my observations in such cases, the lithates are most strikingly deficient; and next to them the urea and saline matters.

In the very last stages, immediately preceding dissolution, the quantity of the urine often becomes remarkably diminished; while

* Dr. Christison on Renal Granular Degeneration, pp. 47—54.

its specific gravity is but little increased. This state of things often ushers in, and accompanies a fatal coma.

Constitutional Symptoms.—In the earlier stages of the confirmed disease, the constitutional symptoms differ little perhaps except in degree from those above mentioned, as occurring in the incipient stages; and the disease usually creeps on so insidiously that the patient can seldom give any satisfactory account either of its cause or commencement. In such instances, therefore, the physician has seldom an opportunity of seeing the affection at the outset; and not perhaps till it has become suddenly aggravated by some accidental circumstance, in consequence of which the patient has been induced to apply for medical assistance. On inquiry, it will be very generally found, in addition to the preceding symptoms, that diuresis in the horizontal position or during the night, has in such cases also been present; and that for months, and even for years, the patient has been in the habit of getting up once or oftener to pass his urine, particularly towards the morning; while during the day he has not been more troubled than formerly. The patient, also, if closely questioned, will in almost all instances acknowledge a consciousness of some uneasiness about the back and loins, occasionally extending to the groins and thighs; while in many cases these symptoms are urgent, and accompanied by a distressing feeling of debility. For the most part also, there is a sense of uneasiness about the urinary organs; and in men in particular, a pain or irritation in that part of the urethra occupying the perineum; which pain or irritation sometimes extends to the point of the penis.

When the affection has existed in the chronic form for a considerable time, there is always more or less of debility, and generally, but not always, of emaciation; the skin also is usually dry; and the general surface, and especially the face, acquires a peculiar pallid and exsanguine aspect. The functions of the digestive organs, and particularly of the stomach, become more and more impaired, and on assuming the erect position in the morning, nausea and vomiting sometimes takes place. There is more or less of thirst; and the patient in consequence usually prefers fluid to solid aliments. The bowels are irregular, frequently constipated; at other times, from very slight causes, relaxed; and the patient is harassed by the discharge of numerous dejections of a

dirty brown unnatural appearance. There is great susceptibility to cold, and from the slightest exposure, the patient is apt to get cold, as it is termed; hence, he not unfrequently labours under a sort of chronic catarrh, particularly during the winter months. This state of things not unusually leads to, or is associated with, inflammation and dropsical effusion into the cavities of the chest or abdomen; particularly if the heart or liver, as is frequently the case, are unsound. Under the same circumstances also, there is commonly anasarca of the lower extremities; though in some cases this is less remarkable than might have been expected; and in a few, dropsy in every form is entirely absent. After a greater or less period of suffering from these or other concomitant affections, during which the powers of life rapidly give way, diarrhoea usually takes place, and still further reduces the patient; who at length becomes oppressed with drowsiness, and finally dies in a comatose state.

Such is the usual history of the constitutional symptoms attending that form of degenerated kidney, termed the granulated kidney. The disease, however, is liable to considerable modifications from the prevalence of one or more of the affections which usually accompany it. Of these, some of the most remarkable are the following:

Under the head of *concomitant diseases*, Dr. Christison has enumerated the following list, comprising some of the most formidable diseases to which humanity is liable; viz., 1. *Dropsy*; 2. *Dyspepsia and Chronic Vomiting*; *Diarrhoea*; 4. *Pleurisy and Peritonitis*; 5. *Catarrh and Pneumonia*; 6. *Coma, with other affections of the Head*; 7. *Chronic Rheumatism*; 8. *Organic diseases of the Heart*; 9. *Organic diseases of the Liver*. In briefly illustrating these concomitant diseases, or rather *predominating symptoms*, we shall follow the order here enumerated.

1. *Dropsy*. Of all the concomitant symptoms accompanying the degenerated kidney, dropsy of the cellular membrane, or *anasarca*, is the most frequent; and indeed, as is well known, this peculiar symptom first drew the attention of Dr. Bright to the disease. A few instances of granular affection have been found, ~~unaccompanied by~~ cellular effusion throughout the whole progress, as above stated; but it so very rarely happens that *anasarca* does not occur at some period or other of the affection, that

it has been considered as one of the essential symptoms of the disease. The other forms of dropsy occur more rarely, and in most instances when present, are accompanied by organic disease of the heart, lungs, or liver.

2. *Dyspepsia* in its severer and most troublesome forms, and *Chronic Vomiting*, are placed by Dr. Christison as next in point of frequency to anasarca; and perhaps correctly, as far as regards "the middle and final stages of the disease."

3. *Diarrhœa* is the disease noticed by Dr. Christison, as most frequently occurring after dyspepsia in connection with renal disease. Like Dr. Bright, however, I have not met with it so often as a symptom in the earlier stages of the affection, as Dr. Christison appears to have done in Edinburgh; though in the last stages of the affection, diarrhœa is very common, and frequently the immediate forerunner of death.-

4. 5. *Pleurisy* and *Pneumonia* occasionally occur as secondary diseases in renal diseases; as does *Peritonitis*; but not nearly so frequently as *bronchial* affections, both acute and chronic. Indeed, as Dr. Christison has remarked, few cases of renal affection occur in the winter months, without more or less of catarrh; which sometimes assumes a severe and unfavourable form.

6. *Coma*, as we have stated, seems to be the natural termination of the disease, and is usually preceded by more or less of urinary suppression. The comatose state is usually ushered in by drowsiness; which should be averted by every possible means, as one of the most dangerous premonitory symptoms. When the drowsiness, as Dr. Christison remarks, "has fairly passed into coma, a fatal result is almost inevitable." In a few instances I have known the earlier stages of the disease accompanied by frequent paroxysms of severe headache; and the latter stages by attacks resembling *epilepsy*; but sanguineous *apoplexy* is rare.

7. *Chronic Rheumatism*, or pains somewhat resembling this affection, I have observed with Dr. Christison to be a common and troublesome attendant of renal affections; especially during the winter and spring months.

8. *Diseases of the Heart* have been noticed by most writers as frequently accompanying renal affections. Cardiac symptoms show themselves, as regards the pulse, in various degrees and modes; i. e. through all the different stages of inflammatory, irritable, and

intermittent pulse, to actual syncope. In the earlier stages, the condition of the pulse is often inflammatory, and sometimes intermittent; in the confirmed stages the pulse is usually more irritable than inflammatory, and more liable to irregularity. Such states of the pulse are not unfrequently accompanied by paroxysms of dyspnoea somewhat resembling asthma; which, in the latter stages, sometimes pass into a tendency to syncope, and finally prove fatal in this form.

9. *Diseases of the Liver*, as well as of the other abdominal viscera, occasionally occur in union with the renal affection, and modify its symptoms. Such combinations are perhaps not difficult to be accounted for, when we consider that by far the greater number of renal affections owe their origin to intemperance.

When we reflect on this formidable list of diseases too often found in connexion with kidney affections, the question naturally arises—what is the bond of union among them? In reply to this question, Dr. Christison remarks that kidney diseases “seem to engender an infirmity of constitution which renders the body prone to disease in general.” That this remark is well-founded there cannot be a doubt; yet I think it inadequate as it stands to explain the phenomena; and that the more general proposition is requisite for this purpose; viz., that certain causes (dram-drinking for instance) produce an infirmity of the constitution in general, and of the urinary organs, as the kidneys, &c., in particular—in other words, that the affection of the kidney is but *one* of the consequences of a generally operating cause; but that such affection of the kidneys, when established, acts in its turn as a *secondary* cause, and still further predisposes the constitution to mischief. And further, (though the point has been called in question by some writers,) in conformity with this view, I agree also in general with Dr. Christison, “that granular degeneration of the kidneys, at a moderately advanced period of its progress, renders the body peculiarly open to the invasion of some epidemic diseases.” In illustration of which proposition he continues, “These organs (the kidneys) have been frequently found far advanced in granular disorganization in cases of death from typhus fever, which for some years has been extensively epidemic in this city. (Edinburgh.) And the same morbid appearance was found in a considerable proportion of the cases of malignant cholera.”

Causes predisposing and exciting.—The primary *predisposing* causes to most renal affections, are inherent ; and, in the present form of disease, the chief primary predisposing cause seems to be nearly allied to, or at least is usually associated with, the strumous diathesis. Besides this general predisposing cause, there cannot be a doubt that, in many instances, a peculiar predisposition to this affection, as well as to other affections of the urinary organs, exists. Of this peculiar predisposition, I think I have seen instances in the children of old drunkards and debauchees, who had died of renal affections ; many of whom have applied to me for similar complaints, at an age, and under circumstances, in which it was difficult to account for their maladies on any other principle. Thus, a slight gonorrhœa, for instance, which, in a healthy person, and under ordinary circumstances, would have subsided, without leaving a trace of evil, has, in such individuals, ended in a troublesome stricture, and ultimately disorganization, of the whole urinary system. Hence, all causes predisposing to affections of the urinary organs in general, may predispose to kidney diseases in particular ; and hence the reason why many of the affections treated of in preceding chapters, as well as those to be spoken of hereafter, become at length complicated with this peculiar affection, and, through its means, immediately prove fatal. As instances of these diseases already spoken of, we may mention a predisposition in the system to form oxalic acid ; or an excess of urea ; or lactic acid, (rheumatism) ; also the acute forms of the affection described in the preceding pages, arising from exposure to cold, from sc̄arlatina, &c. ; in short, all diseases either already described, or to be described hereafter, particularly affecting the urinary organs, strongly dispose the kidneys to take on the present, or some other formidable, malady.

With such predispositions to nephritic affections as those above enumerated, it is not, perhaps, difficult to account for the operation of the various *exciting causes* to be next considered ; for daily experience teaches us, that when a strong predisposition to organic disease exists, and particularly if it be actually established, such organic disease is prone enough to advance in spite of every care. Even the ordinary modes of living, for instance, often co-operate and act as exciting causes under such circumstances : thus a deficient and unwholesome diet, conjoined with unhealthy

and sedentary occupations, develope and confirm the strumous diathesis in general; and when in early life, as is too often the case among the lower classes of society, the abuse of spirituous liquors is superadded, the kidneys in particular suffer; and the present varieties of renal disease, in their worst forms, are speedily established. Indeed, as already stated, and as will be more particularly shown hereafter, the abuse of ardent spirits is, of all others, the most frequent exciting cause of these kidney affections in Great Britain. Among the other exciting causes, exposure to cold is one of the most common. This cause operates alike on all classes of society, but the poor and ill fed are necessarily exposed to its more dire effects. Another exciting cause, which has been stated, in large towns more especially, to co-operate in the production of the present diseases among all classes, are venereal affections; as well as the remedies employed to eradicate the various forms of this multiform scourge. These affections, by establishing inflammatory and organic disease in the urinary organs, are exceedingly liable to institute and excite similar mischief in the predisposed kidneys. The stimulating remedies also, as well as the mercury employed to cure venereal affections, especially if incautiously used, as is too often the case, contribute their ample share towards the same end. Other exciting causes enumerated by authors, are blows or injuries in the neighbourhood of the kidneys; the suppression of cutaneous affections; &c.; all of which, and many others, acting upon, or co-operating with, strong predisposition, rarely fail to develope, in some form or other, the diseases now under consideration.

Before we proceed to consider the *diagnosis, prognosis, and treatment*, we shall briefly describe the *condition of the urine*, the *constitutional symptoms*, and the *causes*, of the second division of renal affections; those, namely, connected with *Hæmotrophy*. We shall then take a contrasted survey of the two great DIVISIONS in connexion, so as to render the General *Diagnosis, Prognosis and Treatment* the more striking.

DIVISION II.

Of Serous Urine; the Kidney in a State of Hæmotrophy; quiescent.

Under this second general division of nephritic affections, distinguished by a serous condition of the urine, we include, as formerly mentioned, those diseases more especially occurring about the middle and subsequent periods of life, in over-fed and plethoric individuals; and which, in consequence, are usually accompanied by hæmotrophy and excessive development, of the different organs. These diseases, like the diseases accompanied by anæmotrophy, we subdivide into *a.* their *incipient stage*, and *b.* their *confirmed stage*.

a. Incipient stage of hæmotrophic affections, as marked by the condition of the urine and general symptoms.—About the age of forty, and in more advanced life, the properties of the urine often become considerably modified in individuals who had not previously considered themselves in bad health. The general action of the kidneys, indeed, often partakes of the capriciousness accompanying the diseases of early life; but the variations in general are less marked, and from slight causes, and sometimes from no assignable cause, the urine assumes the following characters:

The *colour* of the urine is usually natural; sometimes deeper than natural. It is almost uniformly *acid*; and, when passed, is transparent, or nearly so; but on cooling frequently becomes opaque, and deposits a copious sediment of lithate of ammonia, the colour of which varies, in different instances, from a reddish brown, to a dirty clay colour. This sediment usually, after a time, subsides to the bottom of the vessel, and leaves the urine clear; but in certain cases, particularly when oily matter is present, a portion is apt to remain suspended, so that the urine continues turbid, even after filtering. The application of a gentle heat, however, renders it transparent; but if the heat be raised to 130° or 140° , the urine under the above circumstances frequently becomes turbid again from the deposition of albuminous matter—a series of changes characteristic of this variety of urine. The *quantity* of the urine seldom exceeds

the average, and is often below it ; hence the specific gravity is high, and varies from 1·018 to 1·025, or more. Occasionally the action of the kidney is capricious, and the quantity for a short time surpasses the average ; and in this case the specific gravity generally suffers a corresponding reduction ; but this is rare.

Constitutional Symptoms.—We have stated that in early life dyspeptic derangements, more especially of the stomach, constitute the prevalent diseases usually connected with renal affections ; and we may now remark, that about the age of forty and afterwards, affections of the stomach become gradually less frequent, or at least, less troublesome ; and the organs *below* the stomach usually assume the greatest appearance of derangement ; the attacks also at this period of life have usually more or less of the periodical or paroxysmal form ; while in the intervals between the paroxysms, the patient frequently enjoys tolerable health, and the urine is quite free from albuminous matter. These preliminary remarks being borne in mind, the reader will better appreciate the force of the following observations :

The *constitutional symptoms* accompanying the confirmed nephritic diseases now under consideration, are more or less severe in different instances, and vary considerably according to the nature of the organs particularly affected ; as well as according to the degree in which the organs are complicated. A deranged state of the bowels, drowsiness, and other symptoms usually denoting a congested state of the system, and particularly of the hepatic system, commonly precede the attack, which for the most part is immediately ushered in by what is denominated a *cold* ; that is, a disposition to chilliness, followed by dull pain in the loins, and more or less of feverish excitement. The subsequent symptoms vary, and depend in a great degree on the individual predispositions and peculiarities of the patient. Sometimes bronchitis or other thoracic symptoms, as *angina pectoris*, &c., make their appearance, and constitute the leading features of the attack. At other times the abdominal viscera are more immediately involved, and a slight yellow tinge appears in the eyes, or on the skin, &c. In the more unfavourable cases, there is a strong tendency to apoplexy and paralysis ; or to an erysipelatous eruption on some part of the surface of the body ; the lower extremities, also, are apt to become oedematous, and pit on pressure ; particularly towards night.

There is generally with these symptoms a dull heavy pain or uneasiness about the region of the kidneys, accompanied in most instances by irritation about the urinary organs; particularly if these organs are in any way predisposed to derangement. Hence there is often a frequent desire to pass the urine in small quantities at a time; which on the whole is scanty, and presents the phenomena before described.

b. Confirmed stages of Hæmotrophic affections, as marked by the condition of the Urine and general Symptoms.—In the early stages of established hæmotrophic affections the colour of the urine still remains natural, or is deeper than in health; very seldom paler, at least *permanently* paler. The urine is generally acid, and occasionally deposits the lithate of ammonia, which is more or less of a lateritious colour. The secretion also is almost always albuminous, particularly after meals; though in some instances albuminous matter appears only after considerable intervals. The quantity is variable, but generally not surpassing, frequently below, the natural standard. Hence the specific gravity is high, even in the advanced stages; and indeed is seldom very low, that is, below 1·010. In the more advanced stages it becomes impossible to lay down rules generally applicable; as this form of kidney affection is liable as it proceeds to become complicated with a great variety of other diseases, which considerably modify the properties of the urine. In none of these complications, however, except in the instances in which hæmotrophy has begun to pass into anaemotropy, (as into the granulated form of disease, or in a few instances into strumous abscess,) does the urine ever become permanently pale-coloured, large in quantity, or of low specific gravity. Thus in the complication with lithic acid gravel, or with calculous abscess, &c., in the kidney, the urine is often serous and even bloody or purulent; but rarely at the same time permanently pale-coloured, copious, or of low specific gravity. Even when the urine becomes alkalescent, and deposits the phosphates, though the colour may become paler, the quantity is not permanently excessive, nor the specific gravity very low. Indeed the very presence of these complications, which will be elsewhere spoken of in detail, is no bad diagnostic mark of the peculiar condition of the kidney now under consideration, as more immediately contrasted with the pure granulated form of disease; in

which, according to my observations, actual calculous deposite, and even abscesses, may be said to be rare.

The *constitutional symptoms* attending the confirmed, and particularly the latter stages of hæmotrophic diseases of the kidneys, depend almost entirely on the turn the disease may take, either from the predisposition of the patient, or from the accidental exciting causes to which he is subjected. If the patient in middle or advanced life becomes a drunkard, and more especially if he becomes addicted to the use of ardent spirits, the granulated form of disease of the kidney may be superinduced on the hæmotrophied kidney; which, as already stated, may from this cause finally assume an anæmotrophied condition. If the patient be gouty, or has received some blow or other injury about the region of the kidney, the formation of lithic acid calculi, with all their usual train of symptoms to be hereafter noticed, may take place. If he has been subject to cutaneous affections of the scaly kind, with their concomitant symptoms, the oxalate of lime calculus will be most likely to occur; or, finally, if he labour under chronic disease of the bladder, prostate, &c., his case will be likely to become complicated with a deposition of the phosphates in the urine, with all their distressing symptoms; neither of which forms of disease, nor their peculiar symptoms, are, as already stated, according to my observations, of frequent (on the contrary are of most rare) occurrence in the anæmotrophied, and particularly, in the granular form of disease in early life. And when, as is sometimes the case, the symptoms accompanying the anæmotrophied state of the kidneys appear in its hæmotrophied condition, they assume in general very different conditions; thus the dyspeptic, bronchial, rheumatic, and gouty affections sometimes accompanying the earlier stages; and the dropsy, coma, &c., occasionally attending the latter stages of hæmotrophy, usually vary remarkably from the corresponding affections in anæmotrophy.

Causes predisposing and exciting.—Besides many of the causes formerly enumerated as predisposing to renal affections in early life; about the age of forty and in subsequent life, there are commonly superadded a variety of others; such as the rheumatic and gouty diatheses; the effects of a long-continued use of a full diet and free use of wine, and especially of malt liquors; of sedentary habits, or their reverse, severe horse exercise, &c.; but more especially the

consequences of organic degeneration incidental to age; all of which have a tendency to produce a congested condition of the abdominal, and particularly, of the hepatic system; the natural results of which are congestion or hypertrophy of the kidneys, prostate gland, bladder, haemorrhoidal veins, and even sometimes of the veins of the whole lower extremities, which become more or less varicose. In this state of congestion, the particular organ affected is often determined by the action of exciting causes, to be next enumerated.

Of all the accidental circumstances acting as *exciting* causes in the above highly charged condition of the system, errors in diet and exposure to cold are the most frequent. The patient partakes of something which he imagines disagrees with him; or he gets a cold; or both these occurrences take place simultaneously; he has, in short, what he denominates a severe *bilious* attack, accompanied by more or less of fever, and inflammatory congestion of the thoracic and abdominal viscera, or both; and the urine assumes the condition before mentioned, that is, it becomes scanty, turbid, and *serous*. For the reasons stated, the gouty and indolent, who live fully, are most subject to these attacks; but in advanced life, and in the strongly predisposed, they too often afflict the abstemious and active. From the peculiar effects of cold, it happens in general, that these attacks are more frequent in winter than in summer; hence many individuals often get repeated attacks every winter, who pass the summer comparatively well; and in such cases, as formerly stated, the urine, in the early stages of the affection, is often free from albuminous matter. Among other exciting causes of a general nature, one of the most frequent is mental anxiety or grief; or indeed any sudden or great reverse of fortune, subverting the habits and constitution altogether; while among particular exciting causes, the use of surgical instruments, arising from the necessity induced by mechanical or other impediments about the urethra or bladder, is, of all others, perhaps the most frequent. A long list of other exciting causes might be enumerated; but those mentioned amply illustrate the point in question; and are therefore quite sufficient for our present purpose.

General Diagnosis.—For the reasons stated, we shall consider

the diagnosis of the two great DIVISIONS of renal affections distinguished by a serous condition of the urine in early and in advanced life, under one general head. We commence with a few remarks on the phenomena presented by the blood in these affections ; phenomena which not only afford a striking means of diagnosis ; but throw no inconsiderable light on the properties of the urine, as well as on the constitutional symptoms above described.

As my own observations on the properties of the blood in renal affections nearly agree with those of Dr Christison, I shall content myself with referring to his work on the subject for details ; my observations, therefore, will be chiefly confined to the leading facts.

In the earlier stages both of anæmotrophy and hæmotrophy, neither the absolute nor relative proportions of the constituent principles of the blood seem to be much affected ; while the last stages of both conditions of the kidney, and particularly of anæmotrophy, appear to be characterised by anæmia, or a general deficiency of the sanguineous principles. In the progress and different stages and conditions of the affection, however, various circumstances conspire to alter or disturb the relative proportions of the ingredients of the blood ; particularly when anæmotrophy exists. Of these disturbances, the following are among the most remarkable :

Soon after the commencement of these affections, the albuminous (and perhaps the saline) portion of the blood begins to be apparently diminished in quantity—an observation first made by Dr. Bostock during Dr. Bright's researches ; and confirmed by Drs. Christison and Gregory. At the same time, according to these and other observers, urea is generally found in the blood ; sometimes in remarkable quantity. At this period also, the proportion of fibrine is usually increased, while the proportion of colouring matter, or hæmatosin, remains nearly natural." These observations apply, it will be remembered, to attacks of inflammatory excitement occurring in the early stages of anæmotrophic affections. How far they are really applicable to the quiescent conditions of the organs in these stages, I am unable to state ; but I strongly suspect that they do not hold true ; and that in the quiescent state, neither the albuminous matters of the blood are

so much diminished, nor the fibrinous portion so much increased, as above represented ; and that such apparent diminution and increase are rather referable to the inflamed, than to the mere degenerated, condition of the kidney.

In the progress, more particularly of anæmotrophic affections, the relative proportions of the different ingredients of the blood seem to undergo some changes. In the first place, as the proportions of albuminous and saline matters diminish in the urine, they apparently increase in the blood. The proportion of fibrine varies, but for the most part is relatively (sometimes absolutely) greater than natural in the middle stages ; but, in the last stages, the proportion, under all circumstances, usually falls short of the healthy standard. The proportion of hæmatosin in the blood seems to go on steadily decreasing as the degenerating process advances ; so that in the last stages, the quantity of this ingredient is sometimes reduced to less than one-third of the healthy average proportion. These observations more especially apply, as before, to the inflamed state of the kidneys ; and it is probable, as above remarked, that in the quiescent state of these organs, the whole of the sanguineous ingredients are nearly equally diminished : for, as Dr. Christison observes, the blood in the last stages of these complaints, on coagulating, forms a diminutive clot, scarcely constituting a fourth part of the whole weight of the blood ; even when the buffy coat, the result of reaction, is entirely absent.

The conditions of the blood in hæmotrophy of the kidneys, have not been so carefully noticed as those above mentioned in anæmotrophy. As far as my own observations extend, I should say that hyperæmia, rather than anæmia, exists in hæmotrophy of the kidneys ; certainly at least in the earlier stages of the affection. In the latter stages, when, as we have said, hæmotrophy sometimes gradually gives way to anæmotrophy, it is probable that the blood undergoes corresponding changes ; and that ultimately anæmia takes the place of hyperæmia.

Such are the most remarkable phenomena hitherto noticed with respect to the constituent principles of the blood in these affections —phenomena which show most evidently that the affections of the kidney do not constitute the whole disease ; but that, in fact, the disease lies much deeper in the system, and involves more or less

the whole of the great assimilating processes. The phenomena presented by the blood, moreover, are in strict accordance with the phenomena presented by the urine ; that is, in the last stages of the disease, the deficient principles in the urine correspond with, or depend on, the deficient principles in the blood from which the urine is formed. Further, the actually *diseased* state of the kidneys in anæmotrophy enables us to explain the presence of urea in the blood, and of albumen in the urine ; as well as the general absence of the lithate of ammonia, and of the other definite principles of the urine ; while the supposition that, in the earlier stages of hæmotrophy, the function of the kidneys is only *suspended*, but not totally destroyed, offers a plausible explanation of the mixture of the alkaline lithates with the unchanged albuminous principles in that secretion. Lastly, the deficiency of fibrine and of hæmatosin in the blood sufficiently explains the debility, general paleness, and emaciation which characterise the latter stages of anæmotrophy ; while the greater abundance, or even excess, of these principles in the opposite form of the disease, elucidate many of the phenomena of hæmotrophy. Those who feel an interest in these observations, and reflect on them, will be readily enabled to carry the diagnostic differences and explanations connected with the properties of the blood, further ; and indeed to illustrate by their means, many of the minute details of the phenomena presented by the urine.

We come now to make a few brief remarks, chiefly by way of recapitulation, on the general diagnostic differences presented by other circumstances, and particularly by the urine, in the two great DIVISIONS of nephritic affections accompanied by a serous condition of that secretion.

The disposition to anæmotrophy in early life, and to hæmotrophy in middle and the subsequent periods of life ; and consequently the disposition to the diseases connected with these peculiar conditions of the system, furnish us with general diagnostic distinctions, of so striking a character, that we have made them the basis of our arrangement of these affections. Now most intimately connected with these conditions of the system are, as we have stated, the properties and characters of the urine. We shall not enter into details, but merely remind the reader, that in the anæmotrophy of early life, the urine and its sediments are

usually *pale-coloured*, and present a peculiar crudity of texture and aspect, which, to those who have been accustomed to observe on the point, are quite sufficient to distinguish them ; while, on the contrary, the urine and sediments connected with hæmotrophy are usually *deep-coloured*, and more decidedly marked. The *quantity* of the urine, as well as its *specific gravity*, will frequently present a striking contrast ; the quantity being capricious, but on the whole generally *abundant*, and the specific gravity, of *low* average in anæmotrophy ; while, in hæmotrophy, the quantity is more uniform, generally *below* the average ; and the specific gravity is *higher*. When the *serous* character has been once established in anæmotrophy, it is seldom entirely *absent* ; even in the earlier stages of degeneration ; and if for a short time it disappears, it is reproduced by the slightest causes. On the contrary, the *serous* urine of hæmotrophy is often *transient* only, and in the earlier stages, under favourable circumstances, sometimes disappears for many months together. Again, among the constitutional symptoms, the *dyspepsia* of anæmotrophy is generally distinguished by troublesome *stomachic derangements* ; while the dyspepsia of hæmotrophy is more frequently connected with a congested state of the *hepatic* system, and of the *abdominal viscera* in general. Even the *dropsies* so frequently attending the two different forms of disease present to the observant eye many strong points of contrast ; the *anasarca*, for instance, of anæmotrophy is frequently *cold* and *passive* ; while the anasarca of hæmotrophy, particularly in the earlier stages, is often associated with *activity* ; and the swelling is tender to the touch. In the more advanced stages of the diseases, the dropsies of hæmotrophy seem to take place earlier and more frequently in the *great cavities*, particularly of the chest and abdomen, than the dropsies of anæmotrophy ; which for a long period are often almost entirely confined to the *anasarcous* form of the disease. In anæmotrophy of the kidney, *serous effusion* is the most frequent *cerebral* disorder ; while in hæmotrophy there is greater tendency to *sanguineous apoplexy*. The list of diagnostic marks between these two great *DIVISIONS* of disease might be easily extended ; but the above are sufficient to illustrate the subject. To enter into the diagnostic characteristics of the minor symptoms, would carry us far beyond our design, and, after all,

serve no useful purpose ; for those who wish to become acquainted with these diseases, must study them closely, and to such, trifling diagnostic distinctions will be superfluous ; while those who have *not* studied these diseases would be only perplexed by minute details.

General Prognosis.—In illustration of the prognosis in these diseases, we shall, in the first place, make a few remarks on the comparative frequency of renal affections, accompanied by a serous condition of the urine.

Of the comparative frequency of kidney diseases, and particularly of the forms now under consideration, it may be stated, that, on a certain occasion, in Guy's Hospital, Dr. Bright found one in eleven, and on another, one in six of the patients taken indiscriminately, with symptoms of kidney disease ; while in Edinburgh the proportion seems to be still greater. With respect to the comparative frequency of renal diseases at different ages, Dr. B. states that of seventy-four cases, four only occurred above the age of sixty ; thirteen above the age of fifty ; fifty under the age of forty-five ; and nineteen under the age of thirty. I have seen several instances under puberty, and in extreme old age ; and others have noticed the same occurrence. Many of the cases occurring before puberty seemed to have resulted from scarlatina ; while the cases occurring in extreme old age have been generally associated with prostate and bladder disease. In adolescence and middle age, at least three-fourths (in Edinburgh, according to Dr. Christison, four-fifths) of the whole number of cases are caused by the abuse of ardent spirits. Kidney diseases attack both sexes ; but are more frequent in males than in females ; probably because males are more liable to be subjected to the exciting causes.

These observations, it will be understood, more especially apply to the *lower classes in large towns* ; who usually constitute the most frequent inmates of public hospitals. Among the *middle* and *higher classes*, the whole number of cases not only appears to be less, but the proportions seem to be different ; that is, among wine and ale drinkers, the diseases connected with haemotrophy probably exceed those connected with anaemotrophy. It may, however, be observed, that as a habit of drinking too often increases with age ; and as the longer it is indulged, the stronger is

the stimulus required to produce the same effect ; many individuals who in early life had been satisfied with weaker potations, resort to the stronger ones as they grow older ; and on this principle we may probably account for the late development, in some instances, of the granulated form of renal affection ; which, as we have stated, may be thus even superinduced on a previously hæmotrophied organ, and form a mixed kind of disease. In such instances, the hæmotrophied kidney may finally become anaëmotrophic ; but, as already stated, it is exceedingly improbable that the converse change should take place ; for when anaëmotrophy of the kidney is once fairly established in early life, especially by the abuse of ardent spirits, the individual rarely survives the middle age ; so that there is no *time* for a hæmotrophied condition of the kidney to be developed from the opposite condition ; even if it were possible to suppose such a change to occur. But although the general prognosis in renal diseases be thus unfavourable, particularly when connected with anaëmotrophy ; it is not to be considered that they are, under all circumstances, absolutely and necessarily fatal. We come now, therefore, to take a short view of those symptoms which may be considered as more especially favourable, or unfavourable. On this subject, as the following remarks will show, our views nearly coincide with those of Dr. Christison.

First, as regards the properties of the *blood*. When the positive, as well as the relative proportions of the ingredients of the blood are not materially changed ; or when they are no further changed than what results from the inflammatory condition of that fluid ; an early stage of the affection, controllable by appropriate means, is usually indicated. On the contrary, when the proportion of colouring matter is deficient, and its deficiency cannot be referred to previous depletion ; when the blood contains urea, and all its natural ingredients are much below the standard of health ; an advanced and generally irremediable state of anaëmotrophy is denoted.

Secondly, as regards the *urine*. Among the favourable symptoms indicating a generally controllable state of disease, as well as of its concomitant affections, may be mentioned the high specific gravity ; the deep colour ; the moderate or rather diminished quantity ; the abundance of albuminous matter ; and presence of

lithate of ammonia; all of which, particularly if they co-exist, denote in most instances an incipient stage of disease, (both as regards anaëmotrophy, and haemotrophy,) controllable by means to be presently stated. Even when the night urine is of low specific gravity and pale-coloured; provided the day urine be heavier, and the quantity passed in twenty-four hours equals or surpasses the average, the prognosis is not very unfavourable. On the contrary, when the specific gravity of the urine is universally low (below 1·010); when its colour is pale; and its quantity limited; when the albuminous matter, in common with the other urinary ingredients, is very scanty; and the lithate of ammonia in particular, is entirely absent; an advanced state of anaëmotrophy is usually denoted; from which complete recovery is impossible.

Thirdly, as regards the concomitant diseases, much depends upon the stage of the kidney affection. In the early stages, many of the concomitant diseases partake of an inflammatory character, and are thus controllable by the usual means; such are inflammation of the serous membranes, inflammatory dropsy, &c. The dyspeptic, rheumatic, and gouty symptoms, also occasionally occurring in the early periods of the affection, though frequently of an obstinate character, are usually capable of mitigation. On the contrary, in the advanced stages of these affections, the same diseases, when accompanied, as is often the case, with organic lesions of the liver, heart, &c., become absolutely unmanageable, while colliquative diarrhoea, and coma, when fully established, prove inevitably and speedily fatal.

Finally, with reference to the general questions,—how far diseases of the kidneys are entirely *removable*; or, if not removable, how far they are *compatible with life*; we may remark—

First, as to their *removal*.—We have stated that in the very early stages, the disorder appears to be chiefly functional, and therefore removable. Indeed, if anything can be inferred from the mere condition of the urine, as far as the presence of albuminous matters is concerned, even the more advanced stages of the affection are occasionally so far removed, or superseded, as to be hardly distinguishable by the urine; or to be inconveniently felt by the patient. As instances, the condition of the organs usually resulting from early haemotrophy, or from scarlatina,

may be adduced ; after which, the urine is often found quite free from albuminous matter. Such a state of recovery we may consider, with Dr. Christison, to be analogous to a state of recovery from inflammation of the lungs or other organs—a state of recovery so far perfect as regards immediate symptoms ; and becoming so much further corroborated by time, as to give little inconvenience to the patient ; though it may leave him, on the whole, perhaps throughout the remainder of his life, more predisposed to similar attacks, than those who had not previously experienced them.

Secondly, as to the *compatibility of renal diseases with life*. The great risk in renal diseases, throughout all the stages, arises from a disposition to take on inflammatory action. In the early stages, as above stated, these inflammatory attacks, if promptly met, are usually subduable ; while, in the latter stages, they too often prove fatal, in spite of all we can do to arrest them. Now, as the chief exciting causes of inflammatory action in renal affections are exposure to cold ; intemperance, particularly in the use of ardent spirits ; mental excitement ; severe bodily exertion, &c. ; the chance of life, in these affections, very much depends on the peculiar circumstances in which individuals labouring under them are placed ; and on their habits, occupations, &c. ; and if these be all favourable, I am decidedly of opinion that a very large proportion of those who labour under renal affections, may live for many years, and enjoy tolerable health—indeed better health and more comfort than are compatible with many other chronic and incurable diseases. This remark applies more especially to affections connected with haemotrophy, and to certain forms of strumous disease ; in some of which it is often remarkable how long life is protracted under conditions that one would almost conceive to be impossible. Thus I knew an instance of a gentleman, who before the age of twenty, laboured under distinct symptoms of an abscess in the kidney ; who lived to the age of seventy ; and who almost daily, throughout that long period, passed more or less of purulent matter in the urine. His appearance and state of health were never robust ; yet he enjoyed tolerable health and comfort ; and only felt greater annoyance than usual, when the purulent matter, as it would occasionally do, almost disappeared from the urine. On such occasions the

stomach became deranged ; and he had an attack of feverish excitement ; which usually terminated after a short time, in the sudden discharge of an enormous quantity of pus with the urine ; after which he speedily recovered his former state of health. Such attacks were usually brought on by exposure to cold, or by inattention to the state of the bowels, diet, &c. ; and he finally sank under an unusually severe attack of this kind.* Similar remarks have been made by other writers, as for instance by Dr. Baillie ; and indeed it is well understood that one kidney, like one eye or other duplicate organ, may be entirely obliterated ; while the other is quite sufficient to carry on the functions of life. On the other hand, in diseases of the kidneys, connected with anaemotrophy, when the patient is placed in unfavourable circumstances ; when he persists in his intemperate habits ; and, from the nature of his occupation, is exposed to cold and moisture, &c. ; the chance of a protracted existence is very trifling ; indeed, as already stated, such individuals seldom survive the age of forty, and they often die much earlier. Some further remarks on the prognosis indicated by certain symptoms, will be more conveniently considered, when we speak of the effects of inflammatory attacks upon the degenerated kidneys.

Treatment.—The *treatment* of incipient nephritic degeneration in its comparatively chronic and quiescent condition, will vary considerably according to the age and circumstances of the patient. In early life, the complaint, as we have stated, often assumes more or less of the characters of dyspepsia, as well as of derangement of the urinary system ; and the practice must be directed accordingly. The symptoms of dyspepsia are so varied and numerous, that it is impossible to lay down rules with respect to them all. The practitioner, however, will find, whatever his experience in the treatment of dyspeptic affections may be, that in cases of the present description, the dyspeptic symptoms are infinitely more obstinate than usual ; and that very often, whether he considers the dyspepsia as the cause or effect of the concomitant urinary derangements, he will be equally unsuccessful in the treatment of both. The three great points to be con-

* It is remarkable that dropsy rarely appears under this form of disease ; the gentleman alluded to in the text, even to the last, never suffered from œdema.

stantly borne in mind in the management of these cases, are,— attention to diet and regimen ; the guarding against the influence of cold and moisture ; and the avoiding all violent remedies. With respect to diet and régime, it may be observed generally, that the diet should be light and nutritious, and free from stimulating matters ; the purest water should be selected for use ; and of fermented liquors, the less there is taken the better ; though much will depend on this point on the previous habits of the patient. The clothing should be warm, and consist of flannel next the skin throughout the year ; and during the winter and spring months, the addition of leather will, in many instances, be useful. The exercise should be moderate, and short of fatigue ; and if the patient's circumstances admit, easy travelling both by sea and land, warm sea-bathing, &c., may be often recommended with advantage. By *violent* remedies, I mean more especially the abuse of mercury, and of stimulating articles ; such as copaiba, cubeb, turpentine, &c., all of which, when injudiciously administered in exciting doses and in excited habits, are capable of doing infinite mischief. Indeed, I believe a large number of the cases of kidney disease in early and middle life, among the higher classes, are often referable, in no small degree, to the abuse of these remedies.

In the treatment of kidney diseases in early life, it will be frequently proper, at the outset, to abstract blood by leeches or cupping from the loins or perineum in small quantity ; and if the hepatic system be congested, to administer mild but efficient purgatives and alteratives. Of purgatives, perhaps the best is castor oil, if the stomach will tolerate it ; the simple extract of colocynth, conjoined with some aromatic, as the oil of aniseed, &c., often suits well. Rhubarb is apt to irritate from its getting into the urine ; but if it does not irritate, it is in other respects well suited as an aperient. The symptoms more immediately connected with the stomach, are acidity, flatulence, and nausea, which often, in various degrees, co-exist, or alternate. One of the best remedies for all these symptoms is the hydrocyanic acid, either alone or associated with small doses of the fixed alkalies ; to ensure their good effect, however, the alkalies must be carefully and judiciously administered ; otherwise they do more harm than good. When all signs of activity are absent, some

of the lighter bitters and tonics, such as the *infus. humuli* or *infus. cinchonæ*, prepared with cold distilled water, are occasionally beneficial. When the kidneys and bladder are more than usually irritable, as is sometimes the case, the *uva ursi* conjoined with *hyoscyamus*, hop, &c., is often useful; particularly after the other symptoms have been attended to and removed as far as possible. The same may be said of the *diosma* and *pareira brava*, either alone or conjoined with acids, &c., as the properties of the urine may indicate. In this particular state and form of the disease, however, I doubt if any remedy surpasses the *uva ursi* when judiciously directed.

The treatment of incipient nephritic degeneration, and its usual accompaniments as they occur in advanced life, requires, of course, to be varied according to the degree of the disease and the organs more immediately affected. In the acute forms of the affection, when the urine and its sediments are extremely high coloured, and the hepatic system obviously involved in the affection; when, also, there is a tendency to apoplexy, and existing or threatened effusion into the cavities of the chest, peritonæum, &c., blood-letting, general or local, or both, as the case may indicate, will be proper at the outset, with which may be conjoined the judicious use of mercurials, and the more active diuretics; and the patient must, at any rate, and by almost any means, be saved from the imminent danger awaiting him. In the milder form of the disease, however, when the urine is less scanty, and the sediments of a paler colour, there is seldom much occasion for active mercurial treatment. Indeed active mercurial treatment, as before observed, is in a great many cases calculated to do positive mischief; and to confirm, if not to produce, nephritic disease, which, under proper treatment, would have remained stationary at least; or perhaps would never have existed. But while mercurial treatment should be thus carefully avoided, there can be no objection to the use of mild alterative doses of this remedy; either alone, or if gouty irritation exists in the system, conjoined with the acetous extract of colchicum, &c. With these may be associated mild purgatives, and the saline diuretics, such as the supertartrate, citrate, or nitrate of potash, the *spir. aetheris nitrici*, &c. The diet of the patient should be light and moderate; and when the more active symptoms have abated, the diuretic effects

of the remedies may be occasionally assisted by the use of the effervescing waters; to which may be added, if the patient has been accustomed to wine or spirits, a little sound sherry or hock; or a little hollands, if preferred. This plan must be pursued as long as it may appear necessary, or until the urine has acquired its natural appearance and transparency; and when this has taken place, it will often be found on examination, as above stated, that in a great many of the more favourable cases the urine has entirely lost its albuminous character: so as to lead to the conclusion that formidable disease of the kidney never existed.

Nearly the same observations are applicable to the confirmed and advanced stages of renal affections accompanied by serous urine. The diet and regimen, in particular, must be still more rigidly and carefully attended to, and all the barbarous crudities which a vitiated appetite or depraved taste has introduced into modern cookery, should, without exception, be avoided; for whatever affects the stomach, which in most instances is exceedingly liable to be affected by slight causes, is sure to exert an unsavourable influence on the urinary organs. It is impossible to lay down rules which shall be universally applicable; but if the patient confines himself to mutton, poultry, and some of the lighter kinds of fish, among animal matters; and to farinaceous substances, such as bread, rice, sago, &c., together with the occasional use of the lighter herbaceous or leguminous substances, he can scarcely go wrong. In most cases, also, it will be proper to abstain from sugar. With respect to drinks, in addition to what we have above stated, we may observe, that though fermented liquors of all sorts had better be shunned, yet cases will occasionally occur in which it will be proper to break through this rule; for as the greater number of individuals affected by the anæmotrophied forms of disease more especially, have brought on, or at least aggravated, their complaints, by the excessive use of fermented liquors, it will not be prudent, or perhaps possible, in all instances to abstract fermented liquors entirely, and at once; and hence it may be necessary, in some instances, to continue their use for a time, and diminish by degrees the quantity taken. In such cases, those fermented liquors which have a tendency to keep up a moderate flow of urine, will in general be found most useful.

In the confirmed and advanced stages, the exercise must be moderate, and always short of excessive fatigue; and perhaps, on the whole, gentle walking exercise is the best. Rough riding, either on horseback, or in carriages, appears to aggravate the symptoms; and is apt either to cause bloody urine; or in some instances to produce a tendency to urinary suppression. Sailing, when it does not produce too great and long-continued sickness, which it is sometimes apt to do in these affections, is also particularly desirable. All violent exertions, particularly calling the dorsal or lumbar muscles into play, such as lifting weights, &c., should be avoided. The effects of cold should be more than ever guarded against by warm clothing; and the getting of wet feet, or the exposure in any way of the lower extremities or back to the effects of cold or moisture, is particularly dangerous. Hence, whenever the circumstances of the patient admit, he should be recommended to migrate during the winter months to a warmer climate.

In addition to what has been stated respecting the treatment of renal affections in their incipient state, the following observations may be made respecting the medical treatment of them in their confirmed and later stages. One of the first points to be attended to, is the regulation of the bowels; and for this purpose, as formerly stated, castor oil is better adapted than most other expedients. When castor oil disagrees, in addition to the remedies formerly suggested, we may recommend the extract of colocynth combined with the extract of henbane, as advised by Dr. Christison—a combination long in use here, and often very effective. Mercurial remedies, for the reasons we have already so frequently alluded to, are seldom required, or proper in the variety of complaints attended by anæmotrophy, now more particularly occupying our attention. When their use appears to be absolutely indicated, they must be employed with great caution, as a most troublesome ptyalism is apt to be speedily induced by mercury, even in small doses, in these affections; while the affections themselves are commonly much aggravated by its use. A class of remedies much recommended in the confirmed and chronic forms of these affections, is the vapour, or hot air bath. The steady use of *diaphoretics* also is often beneficial, provided their action be at the same time directed to the kidneys; or at least be

not calculated to unduly suppress the action of these organs. One of the best I know is the citrate of ammonia, which, when the stomach is irritable, may be given in the effervescent form. The citrate of ammonia may be variously associated, either with ipecacuanha and the syrup of poppies; or with Dover's powder; the extract of sarsaparilla, &c. I have also found the *infus. diosmæ* with sarsaparilla useful, when steadily employed. Urgent vomiting is best allayed by the hydrocyanic acid, or creosote. In the confirmed stages of the disease, when the abstraction of blood is no longer required or admissible; much benefit is sometimes derived from dry cupping, or the establishment of an issue or seton over the region of the kidneys—not, perhaps, of a curative kind, but the external excitement has seemed to act as a divertissement to the internal; and the tendency to mischief in the kidneys has, in consequence, been not only much diminished, but the attacks, when they have occurred, have been less severe; in short, the complaint for the time has appeared to be arrested in its progress. When the issue or seton has reduced the tendency to inflammatory excitement, remedies of a more decidedly tonic or astringent character may be sometimes employed with advantage; such are the *uva ursi*, the *pareira brava*, and even some of the milder preparations of iron, as the citrate or hydriodate; particularly if conjoined with henbane or conium; but their use requires caution, and they must be immediately discontinued if they cause excitement.

In the early stages of chronic hæmotrophy of the kidneys, the treatment required is almost always of the depletory or antiphlogistic kind. Occasional cupping over the loins; the keeping of the bowels freely open; the use of the alkalies; or neutral saline compounds with vegetable acids, as the citrate or tartrate of potash, will be beneficial. If the urine be scanty, the hydriodate of potash and the *spiritus ætheris nitrici* may be added to the saline mixture. If hepatic or gouty congestion prevails, alterative doses of mercurials, either alone or combined with purgatives, or with the acetous extract of colchicum, may be given at short intervals; so as to meet, or to keep under such symptoms, when threatening, or actually present. Hence, in this form of disease, it will always be proper to pay strict attention to the quantity and quality of the urinary secretion; by which means a coming attack

can be often anticipated, and sometimes warded off, by cupping, by appropriate purgatives, and by other means calculated to obviate local congestion. In the intervals of apparently perfect health, which often exist in the earlier stages of this form of disease, especially during the summer months, little medical treatment of any kind, except gentle purgatives, when requisite, will be necessary; and the patient will have scarcely more to attend to, than the prophylactic means above described. In the more advanced stages of diseases connected with haemotrophy, in which the symptoms usually approximate more or less nearly to those connected with anaemotrophy, the plan of treatment will be of a mixed character, and more nearly resemble that laid down above, as adapted for this form of affection.

With respect to remedies calculated to remove renal affections altogether, I know of none. Even obstinate functional disorders, depending on lesions of the nervous system imperceptible by our senses, too often resist all our attempts to remove them; how then can we hope to remove diseases depending on obvious destruction of the organs?

Finally, in the treatment of renal affections in general, we cannot do better than remind the reader of the maxim often mentioned in these pages, and which should be constantly kept in view, viz. that in all the forms and stages of renal affections, and particularly in the advanced stages, it is much easier to do mischief than to do good; and that the great principles to be kept in view are, to prevent evil as much as possible on the one hand; and on the other, to meet promptly symptoms as they arise, particularly when of an inflammatory character.

**Species b. VAR. 2—*Of serous urine, the degenerated Kidney in
A STATE OF INFLAMMATION.***

We have already pointed out the importance of considering separately those attacks of an inflammatory kind, to which all organic affections of the kidney are liable, and which in fact

constitute one of their most dangerous features. At the same time, however, it must be noticed that these inflammatory attacks are so insidious in their approach, and differ by such imperceptible grades in their early stages from the common quiescent conditions of the organs, that it is difficult, in many instances, to say where one ends and the other begins. Hence, for the sake of distinctness, and to avoid repetition, I have thought it proper, in describing these inflammatory attacks, to adopt a different plan of arrangement, and to speak of the whole in connexion. Moreover, as the inflammatory attacks upon the hæmotrophied kidney are the most strongly marked, I have reversed the order followed in speaking of these diseases in their chronic forms ; and commenced with inflammation of the hæmotrophied organ.

Properties of the urine.—The leading changes in the properties of the urine induced by an inflammatory attack, may be thus briefly stated. In inflammatory attacks of almost every form of diseased kidney, one of the first observable symptoms, as far as the urine is concerned, is a *diminution in its quantity*; accompanied, of course, by a corresponding deepening of its colour, and an increase in its specific gravity. These changes are usually most remarkable in inflammation of the hæmotrophied kidney; in the early stages of which, the urine is often much diminished in quantity, of a deep brown or red colour, and is not only loaded with albuminous matter, but usually, on cooling, deposits large quantities of latcritious lithates. In this stage of the affection, also, blood occasionally makes its appearance in the excretion. As the inflammatory action proceeds, the urine still remains, or even becomes more, scanty; though its colour and specific gravity do not always increase in the same proportion; and in the latter stages, purulent matter is occasionally present. Immediately preceding dissolution, when the affection cannot be arrested, the secretion of urine sometimes ceases almost entirely. Analogous phenomena, though of a much less marked kind, are usually presented by the urine in the anæmotrophied conditions of the kidneys. The quantity, which is usually much more copious than in the hæmotrophied form of disease, becomes more or less diminished at the commencement of the inflammatory attack; the colour, also, is sometimes increased: but the lithate of ammonia is rarely, if ever, present. In the latter stages, the quantity

usually becomes further diminished ; and blood, mixed with mucous and purulent matters, in a few rare instances make their appearance. In the very last stages, when vomiting, diarrhoea, and coma usually supervene, the secretion of urine as before, is nearly suspended altogether. Another property of the urine which sometimes undergoes remarkable changes during inflammatory attacks, is its *acidity*. In the early stages of hæmotrophy, when inflammation supervenes, the urine often becomes preternaturally acid ; and even in the anaemotrophied forms of the disease, and in cases in which the urine is neutral or alkalescent, it will occasionally, under acute attacks, assume an acid character.

When there is abscess in the kidney, particularly of the strumous or chronic kind, the purulent matter almost constantly present, sometimes disappears during the earlier and acute stages ; but towards the termination, after the excitement has given way, the purulent matter is often discharged in greatly increased quantity, to the apparent relief of the patient. In such cases, probably, either the pus has not been secreted ; or having been secreted, it has not been able to escape by its usual exit, on account of the increased swelling, &c., produced by the inflammatory attack. Such is a brief account of the chief variations which the urine undergoes during acute attacks of inflammation supervening on diseased kidneys. There are many modifications of these and other symptoms, incidental to different constitutions and forms of disease, which we cannot here notice ; but which those who are conversant with the subject will, no doubt, easily recognise. We proceed, therefore, to consider the constitutional effects arising from inflammatory action on previously existing diseases in the kidneys.

. *Constitutional Symptoms.*—Inflammatory attacks of the kidneys, in all the forms and stages of degeneration, are usually ushered in by the common symptoms of fever. These symptoms, however, are varied, in infinite modes and degrees, according to the constitution of the patient, and according to the original character of the renal affection. The symptoms are usually most strongly marked in the inflamed hæmotrophied kidney, and may be thus summarily stated. After exposure to some of the common exciting causes of inflammation, as cold, &c. ; and in bladder diseases, after the use of instruments, especially if incautiously

employed, the patient experiences a shivering fit more or less decidedly marked, which is soon followed by the usual consequences, fever, pain in the back and head, restlessness, loss of appetite, &c. As these indications proceed, they become associated with symptoms more especially denoting kidney irritation, such as vomiting, hiccup, and various other forms of gastric derangement ; also, pain and uneasiness about the region of the kidneys, bladder, &c. There is in general thirst ; and the tongue becomes furred, then red, and afterwards brown and dry ; and while these changes are going on, which they do very rapidly, the affection gradually assumes more or less of the typhoid character ; diarrhoea supervenes ; the urine becomes high coloured and scanty, and the patient dies comatose. These symptoms vary considerably, as we have stated, according to the patient's age and strength, and according to the stage of the renal disease ; the symptoms being usually less acute in the old and debilitated, who have long suffered from urinary and bladder diseases ; than in the middle-aged, in whom the constitution has not yet been materially impaired, and in whom the affection is in its incipient state.

The constitutional symptoms denoting increased action of an inflammatory character in the anaemotrophied kidney, somewhat resemble the preceding, but are less decidedly defined, and, moreover, are subject to considerable modifications. The rigor, for instance, at the commencement, is commonly less distinct, and the attack more frequently begins with obvious derangement of the assimilating organs ; exhibited either in the form of dyspepsia, hepatic congestion, or disordered state of the bowels, or all these combined, or associated with others. In this state of things, any little error of diet will often give occasion to the attack, which is not unfrequently aggravated by vomiting or diarrhoea, or occasionally by both. In some instances the urine, under the above circumstances, becomes more scanty than usual, and the attack is ushered in by a drowsy listlessness, or headache ; and, on account of the diminished quantity of urine secreted, there is a temporary lulling of the ordinary bladder irritation. In a variety of instances, particularly during the winter months, the attacks commence with a common cold, which is accompanied by a strong tendency to bronchitis or pneumonia. In some instances, diarrhoea, in others,

anasarca, are among the first symptoms that attract the patient's notice, and indicate increased disease in the kidneys; in short, any of the concomitant symptoms previously mentioned, as well as many others depending on accidental causes, and the peculiar circumstances of the patient's constitution, often determine both the kind and degree of the immediate attack, and consequently the risk accompanying it; as well as in a great measure, the principles of treatment.

With respect to the termination and consequences of inflammatory attacks of the degenerated kidney, not proving immediately fatal, it may be noticed generally, in conclusion, that they differ materially in the two forms of the affection now under consideration; as well as in the same form, under the different modes of attack above alluded to. In the haemotrophied kidney, the attack is sometimes terminated by a discharge of blood from the organ; occasionally by a discharge of pus; not unfrequently by neither; but in almost all instances it will be found, that after every attack the patient is left in a worse and more susceptible state than before; and that it is long before he recovers his former condition, and frequently never. Similar remarks may be made respecting acute attacks of the anaëmotrophied kidney. In a few rare cases they are resolved by an attack of haemorrhage; or a discharge of pus; but the patient is much more apt to get into a general cachectic state, terminating in some of the chronic affections above described. In cases in which the mucous membrane is involved, irritable and diseased bladder is another very frequent termination; which, added to the constitutional derangement, increases infinitely the distress of the patient, and generally abridges his existence.

With respect to the *causes* of inflammatory attacks on the degenerated kidney, as well as the *diagnosis* and *prognosis*, we need not, after what has been stated, enter into details. We shall, therefore, content ourselves with referring the reader to what has been said on these subjects when treating of the disease in its quiescent state; and proceed at once to make a few remarks on the plan of treatment.

Treatment of Inflammatory attacks of the degenerated Kidney.—We need scarcely state that the principles, as well as many of the details of the treatment to be pursued in inflammatory at-

tacks of the degenerated kidney, have, like those of the causes, diagnosis, and prognosis, been already anticipated ; under these circumstances, we shall principally confine ourselves to a recapitulation of the leading facts.

Inflammatory attacks on the hæmotrophied kidney should be promptly met at the very outset by active antiphlogistic treatment. A few cases will require general blood-letting, and almost all will be much benefited by local depletion ; such as by free cupping or leeching over the loins, &c. Blisters are doubtful remedies ; though, if not kept on too long, they may be sometimes useful ; but strong mustard poultices, or other effective counter-stimulants, producing speedy and decided effects, are preferable. Internally, active aperients may be usually administered ; among which calomel and colchicum may be included ; especially, as is often the case, if gouty irritation be suspected, or present. When the more active symptoms have subsided, the purgatives may be associated with diuretics ; or diuretics may be given alone, as the case may appear to indicate. Of diuretics, the citrate, tartrate, or supertartrate of potash, conjoined with nitre, the hydriodate of potash, the *spir. aetheris nitrici*, &c., are among the best, and may constitute a part of the prescription. When the urine has assumed its usual quantity and properties, we may conclude in general that the inflammatory attack has subsided ; though the urine will be often found to contain more or less serum for a considerable time (in some cases *always*) subsequently to the attack ; particularly after meals. The above remarks apply more immediately to the earlier and acute attacks ; but a similar plan of treatment, modified according to circumstances, is usually indicated throughout all the stages of the affection. In the latter stages, purgatives must be given with more caution ; but diuretics are occasionally required to the last, to remove the increased or sudden dropsical effusion, which frequently takes place, either into the cellular membrane, or into the thoracic or abdominal cavities, during subacute inflammatory action, produced by exposure to cold, or by other causes.

In the inflammatory attacks of the anæmotrophied kidney, the symptoms, though of a still more formidable character than those attending inflammation of the hæmotrophied kidney, are seldom so acute ; that is, are rarely of the high phlogistic character of

those exhibited by the hæmotrophied kidney. Hence general depletion must be cautiously resorted to ; and local blood-letting, by leeches or by cupping over the loins, if blood-letting be at all indicated, will be safer than general depletion. In inflammation of the anæmotrophied, as well indeed as of the hæmotrophied kidney, the application of leeches to the perinæum and anus will be often found particularly useful ; and the bleeding may be encouraged according to circumstances, by applying a large warm poultice to the part. In the confirmed stages of the affection, when bleeding in every form is out of the question, dry cupping over the loins is sometimes useful. In the last stages, the symptoms, which are usually of a colliquative kind, must be combated as they arise, according to their nature and degree. Diarrhœa is a frequent and formidable symptom, and usually resists any attempt to abate it; diarrhœa sometimes precedes effusion on the brain and coma; a tendency to which the sudden checking of the diarrhœa, either spontaneously, or by opiates, seems to promote. In short, the treatment of the latter stages of inflammatory attacks, both of the hæmotrophied and anæmotrophied kidney, when the more acute symptoms have abated, differs in no respect from the treatment of those diseases in their chronic and quiescent forms, as before detailed.

It would be foreign to the objects of this volume to enter minutely into the treatment of all the various secondary diseases occasionally accompanying renal affections. I cannot, however, conclude without repeating the caution—that in the treatment of these affections, the medical practitioner must *never overlook the renal disease*, otherwise he will be more likely to *kill* than to *cure* his patient. *

In the preceding account of renal affections, characterised by a serous state of the urine, all allusion to the condition of the kidneys with which this morbid character of the urine is commonly associated, has been omitted in the present edition, and I have thought it preferable to arrange the constitutional symptoms and the morbid anatomy of the kidneys separately. In accordance, therefore, with this view, it remains to give a brief summary

—first, of the *apparent post mortem* phenomena in these diseases ; which we shall do in the words of M. Rayer,* and Dr. Christian,† whose classifications of these diseases are chiefly founded on the *apparent post mortem* phenomena :—and secondly, of the principal *microscopic phenomena* presented by the kidney and urine, as more especially determined by recent investigations.

M. Rayer comprises the diseases connected with a serous state of the urine, under the general appellation of *Nephrite Albumineuse* ; which he divides into the *acute* or *febrile* ; and the *chronic* or *non-febrile*. From the different appearances found after death, he further subdivides these affections into six varieties ; two of which varieties belong to the *acute*, and four to the *chronic*, forms of the affection. The following is his account of these six varieties :

First Variety. (See M. Rayer's *Atlas*, pl. vi. fig. 1 ; and pl. x. fig. 3.) The size of the kidneys is augmented ; in the adult, the weight of one of the kidneys is increased to eight or even twelve ounces, instead of four ounces, the average weight. Their consistence is firm without hardness ; somewhat resembling that state of the organ which is produced by injecting it with a watery fluid. Their surface, which is more or less unnaturally red, appears studded over with a great number of little points, of a deeper red than the general tint of the organs. On making a section, the augmentation of volume is found to chiefly depend on the distension of the cortical portion of the kidney, which presents internally a great number of red points similar to those which are observed on the surface of the organ. These red points M. Rayer thinks to be the glandules of Malpighi, strongly injected with blood. The tubular structure of the kidney, compressed between the tumified prolongations of the cortical structure which extend between the pyramids, is of a more ill-defined red, and its striæ are less apparent than in the healthy state. Lastly, the mucous membrane, lining the calices and pelvis of the organ, is more vascular than natural. This condition of the kidney is considered as rare ; since death seldom takes place till the affection is further advanced.

* *Traité des Maladies des Reins*, tom. ii. pp. 99—104.

† *On Granular Degeneration of the Kidneys*, p. 91.

Second Variety. (See M. Rayer's *Atlas*, p. vi. figs. 2 and 3; and pl. vii. fig. 5.) The size and weight of the organs, as in the preceding variety, are augmented. The consistence is a little less firm. The lobules are frequently more distinct than in health; but the point that particularly distinguishes this variety is a remarkable admixture of anaemia and hyperæmia; a marbled aspect of the surface of the kidneys produced by red spots disseminated over a ground of a whitish yellow tint. When cut open, the cortical portion of the organ is found enlarged, and of a pale yellow tint, spotted with red, which is strongly contrasted with the tubular structure; the colour of this being of a decided reddish brown.

Third Variety. (See M. Rayer's *Atlas*, pl. vi. fig. 4.) The size of the kidneys is increased as before; but the appearance of the surface is neither spotted nor marbled. The cortical substance of the organ, both external and internal, is of a pale uniform rose or yellowish tint; or occasionally the colour is still less marked, and resembles that of the flesh of the eel. (*Atlas*, pl. x. fig. 5.) Minute vessels, injected with blood, appear here and there. (*Atlas*, pl. vii. figs. 2 and 5; pl. ix. fig. 9; pl. x. fig. 10.) More rarely, small red or brown spots, or large white granulations, denote a former deposition of lymph (*Atlas*, pl. vi. fig. 6) or depressions. Occasionally redness and hardness of the mamillary processes of the tubular structure are observed; as well as a slight thickening of the mucous membrane lining the calices and pelvis, the vessels of which are sometimes injected. These phenomena are not, however, to be considered as characteristic, as they are also seen in common nephritis.

Fourth Variety. This has been designated by Dr. Bright as the *granulated texture of the kidney*. (*Atlas*, pl. viii. figs. 1, 2, 3, 4, 5, 6; pl. ix. fig. 1, 8.) As in all the preceding varieties, the kidneys are larger and heavier than in a state of health. Their external surface most frequently is of a pale yellow, and sprinkled, and sometimes covered, with small spots of a *milk white* or slightly yellow colour* of the size of a small pin-head. The

* M. Rayer observes that the term *yellowish granular matter*, generally adopted in this country to designate this morbid phenomenon, does not convey an exact notion of the most frequent appearance assumed by the granular degeneration.

spots are occasionally elongated, and somewhat resemble the light curdy deposit from whey, and are scattered more or less irregularly over the surface of the organs. In general the granulations are more numerous and striking at the extremities of the kidneys. They are all covered with an extremely thin membrane, through which they appear as if overlaid with a coat of varnish. The surface of the organs is perfectly smooth, and of a milk-white colour. The granulations of Bright are found in the cortical substance of the kidney. When the kidneys are divided on their convex side towards their scissure, the cortical substance offers, as in the second and third varieties, a general pale yellowish tint, which is strongly contrasted with the red colour of the tubular structure. The distended cortical portion occupies a larger space than in health, particularly in the prolongations between the pyramids. The minute points of a milk-white colour, instead of being more or less round and separated, as is most frequently the case on the surface of the organs, (*Atlas*, pl. ix. fig. 1,) appear under the form of irregular flocklike lines, which seem continuous with the diverging striae of the tubular pyramids. (*Atlas*, pl. viii. figs. 1 and 5.) When the section is carefully made in the direction of the striae of the tubular substance, the above distribution is very apparent; particularly at the periphery of the kidney, and at the bases of the pyramids; where the granular alteration is in general the most strongly marked.

Sometimes the granular deposit is scanty or entirely wanting in the interior of the cortical substance, although it may be very abundant on the surface of the kidney. In other cases, on the contrary, the granular degeneration occupies all the depth of the cortical substance, and extends to the little prolongations which penetrate to the base of the tubular pyramids; the striae of which are jammed and depressed on their sides, so as with their floating extremities to somewhat resemble a wheat-sheaf. (*Atlas*, pl. ix. fig. 8.)

When a granulated kidney is macerated in water for some time, the granular deposits become more apparent. Their dead-white colour, also, strikingly contrasts them with the surrounding cortical substance. (*Atlas*, pl. ix. fig. 1.)

Fifth Variety. This form, more rare than the preceding, is, like them, sometimes accompanied by dropsy. The kidneys are,

as in the former instances, more enlarged and heavy, and have a more decidedly lobulated appearance than in health. I cannot, says M. Rayer, give a better idea of the appearance presented by the organ in this variety, than by saying that it resembles an infinite number of minute grains of oatmeal, deposited under the investing cellular membrane. These little grains are quite distinct from the grains of sabulous matter sometimes deposited in the cortical substance; as they are also from the little lymph granules, which are occasionally seen in this, as well as in other varieties of nephritis.

Sixth Variety. This variety appears to correspond with Dr. Bright's third variety. The kidneys are sometimes larger, frequently smaller, than in health. (*Atlas*, pl. vi. fig. 5; pl. vii. fig. 6; pl. x. figs. 8 and 10.) They are hard, and present mammelated inequalities on their surface. There are few or no milk coloured spots externally; but on making a section of the organ, granulations are almost always seen in the cortical substance. I have also seen a kidney in this state of induration and unnatural form, present a great number of granulations on its surface. (*Atlas*, pl. vii. fig. 6.)

In cases in all respects resembling the preceding, in which the patient has died some months or years after a first attack of serous urine, I have in vain, says M. Rayer, searched in the indurated, rugose, and mammelated kidneys, the true granulations of Bright; for we cannot give that name to the minute projections or asperities with which the surface of the organ is ordinarily scattered. The kidneys are most frequently discoloured, either generally or partially; and, anatomically speaking, they so resemble the kidneys as altered by simple chronic nephritis, that it would not be possible to point out the distinction without a knowledge of the phenomena which occurred during the lifetime of the patient.

In this advanced stage of the disease the exterior membranes of the kidneys are almost always thickened, at least partially; and are strongly adherent to the surface of the organs.

The following are some of the most frequent morbid appearances occurring in conjunction with the present forms of diseased kidney.

1. The glandules of Malpighi are red or dark-coloured, and

much enlarged ; (First form of the disease, *Atlas*, pl. vi. fig. 1 ; pl. x. fig. 3;) and this discolouration is remarkable, when anaemia pervades the cortical substance of the kidney. In the advanced stage of the disease, the renal glandules assume the form of minute serous vesicles ; (*Atlas*, pl. ix. figs. 6 and 7;) intermingled with others of a larger size, which, as the disease proceeds, become real cysts.

2. The little red ecchymosed or petechial spots which are sometimes observed in the first form of the disease, may be subsequently replaced by yellow or slate-coloured spots. (*Atlas*, pl. vi. fig. 6.)

3. The renal veins may present fibrinous concretions, adhering to their sides, (*Atlas*, pl. vii. fig. 3,) and extending to their principal ramifications. In this case a section of the cortical substance appears more moist than when this condition of the veins is absent. The lymphatic glands of the renal scissure are sometimes enlarged ; but this is very rare.

4. The calices and pelvis have several times shown traces of inflammation both acute and chronic ; acute inflammation has been indicated by vascular arborisations or red spots ; chronic inflammation by a dull or bluish-white appearance of the mucous membrane ; which in two cases has been seen partially ulcerated. (*Atlas*, pl. x. fig. 1.)

M. Rayer supposes organic derangements of the bladder, prostate, &c., to be only accidentally associated with kidney disease ; while he considers organic affections of the lungs, heart, stomach, &c., to be more intimately connected with renal affections, either as causes or consequences. Anasarca he views almost as a necessary consequence ; and observes, that instead of mere serosity, a gelatinous fluid is sometimes deposited in the cellular tissue.

The following is Dr. Christison's arrangement of the present diseases.

"On comparing," says Dr. Christison, "with my own observations, the experience of *Dr. Bright*, *Dr. Gregory*, *M. Solon*, and *M. Rayer*, as well as the more limited facts published in the journals by other authors, it appears to me that the following appearances ought, in the mean time, to be distinguished, with the view of afterwards tracing their relationship : 1. Congestion of the

kidneys, with or without some granular deposit in their substance. 2. True granular degeneration of the cortical or tubular structure; *a.* finely granular; *b.* botryoidal. 3. Degeneration by a smooth homogeneous yellowish gray mass, intermediate in consistence between that of the liver and that of the brain. 4. Disseminated tubercles. 5. Induration, of semicartilaginous hardness. 6. Atrophy, with disappearance of the proper renal structure, and with or without one of the previous morbid states. 7. Simple anaemia. The last is of doubtful existence as a local affection, or independently of general anaemia; and in all probability the cases which have been considered such, were really cases of anaemia with granular deposit."

The preceding description of the *apparent post-mortem* phenomena found in connexion with a serous condition of the urine, as well as the arrangements deduced from them, are, in a *practical* point of view, of very little importance. They show us indeed *why* a serous condition of the urine so generally proves fatal; but this is by no means the whole, nor even the chief information we expect to obtain from such inquiries. The great object of *post-mortem* investigations is to render the dead available to the living. In other words, is to discover the *exact mode* in which the disease kills, so as to enable us to judge how far, and on what principle, the fatal tendency can be obviated.

In the history of renal diseases connected with serous urine above given, we have shown, that in the greater number of instances, it is not the mere degenerated condition of the kidney which proves fatal; but some remote influence exerted on a distant vital organ; or still more frequently some inflammatory action set up in the degenerated organ itself. The *post mortem* phenomena therefore should illustrate these important facts, and thus assist us in detecting their existence during the lifetime of the patient. Studied in this manner the phenomena found in the dead body would indeed become available to the living; and we might learn from them not only what we cannot do, but what is really in some degree within our power. In other words, the *post mortem* phenomena thus understood, would assist us in no small degree in warding off, perhaps in subduing, by far the most fatal adjunct of these diseases—the inflammation.

Nearly the same remarks apply to the distinctions between anæmotrophy and hæmotrophy. Like the phenomena of degeneration and inflammation, the phenomena of anæmotrophy and hæmotrophy are obscurely pourtrayed in the preceding *apparent post mortem* descriptions, as in their well-marked forms indeed, they could hardly fail to be ; but no one to my knowledge has attempted to contrast and generalize these phenomena ; nor to deduce from them those practical inferences to which such a contrasted generalization leads—a task, therefore, which from its great importance I have at all hazards attempted ; not only with the hope that it will lead to something better hereafter, but that even in its present imperfect form it will not be altogether valueless.*

Microscopic Anatomy and Phenomena presented by the kidneys and urine in Albuminous urinary diseases.—The preceding account of the *apparent post mortem* phenomena, presented by the kidneys in albuminous urinary diseases, as well as the observations on their little comparative value when considered *alone*, have been permitted to remain as in the last edition. This has been done because a knowledge of the apparent phenomena is necessary to a due understanding of the microscopic phenomena to be now given. With regard to the microscopic phenomena, the reader will observe that, as in the case of the apparent phenomena, the microscopic are far from being complete ; and that much yet remains to be done in both departments before their exact relations can be thoroughly understood. In the mean time, we offer such data as we possess ; which though imperfect are sufficient to show their value, and to point out the way to a more complete history of the subject.

In introducing our account of the microscopic phenomena, we

* So long ago as 1825, when the second edition of this volume was published, I had recognised the striking differences assumed by the urine in these two forms of disease ; but the conditions of the kidneys with which they were connected, were unknown to me. Dr. Bright pointed out the state of the kidney (anæmotrophy) more especially connected with the first form of diseased urine. The connexion of the peculiar condition of the kidney (hæmotrophy) with the second form of diseased urine, as far as I know, has only been recognised by myself. See Second edition of this work, p. 48.

cannot do better than give the following quotation from Mr. Simon, which will convey a general idea of the whole subject :

"Inflammations of simple mucous membranes," says Mr. Simon, "mainly evince themselves in derangements of the secreting functions ; and especially if subacute, by no means necessarily imply any submucous deposit of organizable material. The modified secretion of such a surface may be eliminated with a rapidity that renders accumulation impossible ; and then (as in gleet or in ophthalmia,) how little beyond a doubtful hyperæmia would remain for the morbid anatomist ! All this is notoriously true in respect of mucous membranes ; it is equally true, though less notorious in respect of *the true glands* ; which are but processes, or involutions of the same structure. No interstitial effusion of lymph need exist in a gland to warrant us in accounting it inflamed ; its inflammation may consist simply in functional derangement, and during life may be recognised only by admixing its albuminous products with those of normal secretion.

"There is however a momentous difference in the two cases. The simple mucous membrane sheds from its surface whatever inflammatory secretions may be formed there ; it is quit of them ; they cannot react on it injuriously. But the glands have not the same facilities for eliminating morbid products ; in proportion to the complexity of their structure, and to the narrowness of their canals, they must be liable to embarrassment from changes in the physical qualities of their own secretions ; the delay, accumulation, and obstruent action of which would, it is obvious, suffice to derange the whole microcosm of the organ in which it might occur ; and thus an amount of irritation which in a simple mucous membrane would be utterly insignificant, may, if transferred to a gland, serve to originate its complete disorganization.

"These preliminary remarks will not, I hope," continues Mr. Simon, "appear to be otherwise than appropriate. The influences just alluded to are precisely those which most of all illustrate my subject : for it is under their operation in the kidney that the lowest amount of inflammatory action, or even an excitement of function, hardly rising to inflammation, may and does by its secondary and reactive results, become a thoroughly irreparable disease. Without dwelling on those excessively rare cases, where idiopathic nephritis, (independent of tubercles or of calculus) may

by its mere intensity have ended in large suppuration or (almost uniquely) in gangrene ; I may state that in an infinite majority of instances, inflammation of the kidneys is subacute. It depends on some humoral derangement of the entire system, and commences as functional excitement, manifested in an act of over-secretion. The morbid material which thus stimulates the kidney in its struggle for elimination will sometimes consist of products of faulty digestion—the lithates or the oxalates ; sometimes of matters cast on the kidney in consequence of suppressed function in other organs,—the skin or the liver ; sometimes will be the mysterious ferment of a fever poison—typhus or scarlatina. In these several cases, whatever variety may exist in the detail of their causation, the essential symptoms during life, and the essential anatomical changes, are strictly identical in kind ; they vary only in degree. The *materies morbi*, seeks to effect its discharge by means of an increased activity in the secreting functions of the kidney ; it stimulates this organ, and the result of the stimulation is not so much an increase of the watery secretion, as it is an augmented cell growth in the tubules of the gland. This acceleration of function is incompatible with maturity of the secreted products ; the epithelial cells undergo various arrests or modifications of development, and become more or less palpably imbued with evidences of inflammation."

" If attention happen to be directed to the state of the urine, that fluid will be found to present manifest signs of derangement. Microscopical examination will show in it numerous nucleated cells, which in the hurry of over-secretion have descended from the urinary tubules. Many free cytoplasmic cells will likewise generally present themselves, together with a variety of those indefinite shapes, which are known to the morphologist as abortions of cell-growth ; and which constitute a series of connecting forms between the pus globule and the healthy gland cell. Mingled with these, in greater or less quantity, will be noticed also those remarkable fibrinous threads first described by Franz Simon, in connexion with renal disease. They are seen as exceedingly delicate, almost perfectly transparent and colourless cylinders, often containing in their mass some of the cell forms just enumerated ; or not unusually a few blood discs resulting from haemorrhage into the tubules.

"On several occasions when the renal irritation has been gouty, I have seen crystals of lithic acid thus entangled in fibrin; in other cases, though far less frequently, I have distinguished crystals of oxalate of lime similarly enveloped. It is well known that these little cylinders are fibrinous moulds of the inflamed urinary tubules, some of the other contents of which they bring with them in their descent; they are thus quite as characteristic of the disease they attend, as croupy expectoration is of trachitis; and the cells or crystals included in them often afford the most valuable therapeutical indications.

"Of course under all the circumstances last mentioned, the urine contains *albumen*, and will yield a precipitate with nitric acid; but so much more delicate is the microscopical than the chemical test, that it has twice happened to me, (Mr. Simon,) in cases of scarlatina, to find groups of blood corpuscles in the urine when nitric acid had given no precipitate visible to the naked eye."*

This long quotation from Mr. Simon has been given, because, as we have stated, it contains an outline of the whole subject. If the facts and principles here stated, together with those to be given from Dr. Johnson and others, be carefully studied and understood, there will be little difficulty, by the aid of the usual well-known chemical expedients, assisted by the microscope, in determining with tolerable accuracy, in any given case, the nature of the renal disease, as well as its degree.

It would be foreign to the object of this work to enter into a detailed history of all that has been done on these subjects. The reader who is interested in the inquiry will not fail to make such investigations for himself. My object is chiefly to present a practical outline of the facts generally admitted, and to show how far they illustrate and confirm the views taken of renal diseases in the preceding pages. On some points in the microscopical history of these diseases, there is still considerable diversity of opinion among observers; and it is very probable that further researches will throw additional light on matters at present but imperfectly understood. Though much has been done, therefore, the time is

* Med. Chirurg, Trans. vol. xiii. p. 142, new series. I have many times seen blood-discs in the urine, when that fluid was not sensibly serous by nitric acid and heat.

not yet come for writing a complete history of renal diseases connected with scrous urine.

Before proceeding, we may remark, that the urine to be examined should be allowed to stand for some hours in a tall glass vessel, in order that the morbid matters may settle at the bottom. The clear portion of the urine is then to be poured off, and the sediments well mixed with the remaining portion of urine, and submitted to examination.*

As our information does not permit us to illustrate all the different varieties of renal diseases noticed in the preceding pages ; we shall consider them under the two general heads of—*Diseases of Haemotropy* ; and—*Diseases of Anæmotropy*.

Of the microscopic phenomena presented by the kidney and urine in Haemotrophic diseases,—acute desquamative nephritis of Dr. Johnson.—As an instance of acute Haemotrophic diseases of the kidney, we may take the account given by Dr. Johnson of the phenomena presented by the *inflamed kidney* of a girl who had died a few days after symptoms of renal disease had manifested themselves in scarlatina.—“ The gland is enlarged apparently by a deposit of a white material in the cortical substance ; the vessels in the cortical portion, where they are compressed by this material are injected and of a bright red hue ; the pyramidal portions are of a dark red colour, in consequence of the large veins which occupy those portions of the gland being distended with blood. The appearance of the entire organ is quite that of a part in a state of acute inflammation.

“ On a microscopical examination, the convoluted tubes are seen filled in different degrees with nucleated cells, differing in no essential character from those which line the tubes of the healthy gland. The chief difference between those cells which are the product of inflammation and those which exist in health, consists in the former being generally of a smaller size and more opaque and dense in their texture. The straight lines which form the pyramids, also contain an increased number of eells ; but there is

* Since I first contrived, twenty-two years ago, the urinometer, now generally employed, I have been in the habit of using tall narrow glasses, adapted at once for the use of that instrument ; and for allowing the sedimentary matters to collect at the bottom for microscopic examination. Thomson's Annals of Philosophy, vol. ix. p. 334, new series, 1825.

reason to believe that these are not formed in these portions of the tubes; but that they are lodged there in their passage from the convoluted, through the straight tubes; the latter being merely ducts leading into the pelvis of the kidney. Some of the tubes contain blood, which has doubtless escaped from the gorged malpighian vessels lying within the dilated extremities of the tubes. There is no deposit outside of the tubes. The essential changes in the kidney are an increased fulness of the blood-vessels, and an abundant development of epithelial cells, differing slightly in general appearance, size, and consistence from the normal renal cells; this increased cell development occurring in those portions of the urinary tubules, the office of which, as Mr. Bowman has suggested, is to excrete the peculiar saline constituents of the urine; while the malpighian bodies, whose office is the separation of water, are unaffected.

"The condition of the urine in these cases is clearly indicative of the changes occurring in the kidney. After the urine has been allowed to stand for a short time, a sediment is formed; and on placing a portion of this under the microscope, there may be seen blood-corpuscles, with epithelial cells in great numbers, partly free and partly entangled in cylindrical fibrinous casts of the urinary tubes; and very commonly numerous crystals of lithic acid are present. As the disease subsides, the blood, fibrinous cysts, and epithelial cells diminish in quantity, and finally disappear; but traces of the casts and cells are still visible, some days after the urine has ceased to coagulate on the application of heat or nitric acid.

"The casts and cells which appear in the urine when the disease is subsiding, are such as have remained some time in the urinary tubes, before they have become washed out by the current of fluid poured into the tubes from the malpighian bodies; many of the cells entangled in these casts have consequently become disintegrated and broken up into amorphous granular masses; thus presenting appearances which I shall presently show are characteristic of the casts occurring in chronic nephritis."*

Such are the microscopic phenomena, according to Dr. Johnson, presented by the kidney and urine during an acute attack of inflammation supervening on scarlatina. Dr. J. observes, that very

* Med. Chirurg. Trans. vol. xxx. p. 167. General series.

similar phenomena are presented during acute inflammatory attacks of the kidneys from other causes ; as from exposure to cold ; from the sudden suppression of eruptions, &c. With this opinion I am, from my own observations, disposed to agree ; though it is probable that minor and perhaps characteristic differences will be hereafter detected in the various forms and conditions of hæmotrophic diseases.

Microscopic anatomy and phenomena in Anæmotrophic renal diseases.—As intermediate between Hæmotropy and Anæmotropy, and in some of their forms perhaps, belonging to both ; we shall give the microscopic anatomy and phenomena in those diseases which Dr. Johnson has considered to depend on

Fatty degeneration of the kidney.† When Dr. Johnson first announced that “ Bright’s disease may be described as *primarily and essentially an exaggeration of the fatty matter which exists naturally in small quantities in the epithelial cells of the healthy kidney,*” I demurred to the general accuracy of his opinion ; for though fatty degeneration might constitute one element, or even one variety of the multi-form diseases confounded under the common name of “ Bright’s disease ;” I felt quite satisfied that many of the diseases so confounded had quite a different origin. Dr. J. now admits this to be the case : and in his recent paper above quoted, has pointed out not only the inflammatory disease described in the preceding paragraphs : but other forms to which the term “ Bright’s disease,” as I understand it, is more strictly applicable ; and which he admits, do not depend in any way on fatty degeneration.

Dr. J. observes, “ I will venture to assert, that in fatty degeneration of the kidney, there is no inflammatory or congestive stage preceding the deposite. The congestion which often accompanies the disease, and which is a consequence of previous morbid changes, may be either active or passive. The way in which passive congestion occurs (by the accumulation of fatty matter in the urinary tubercles, &c.) has already been sufficiently explained. Active congestion may

† Med. Chirurg. Trans. vol. xi., second series, (vol. xxix. general series,) page 1. Dr. J. has entitled his paper “ On the minute anatomy and pathology of Bright’s disease of the kidney ; and on the relation of the renal disease to those diseases of the liver, heart, and arteries with which it is commonly associated.”

be thus accounted for,—a large number of the epithelial cells become gorged with fat, and their secreting function is in consequence impaired; those portions of the gland which are less involved in the disease, are now called upon to do an increased amount of work; this may lead to active congestion and the consequent effusion of serum and blood into the tubes. In many cases there probably exists both active and passive congestion of the vessels, but I repeat that this is the consequence, not the cause of the deposite in the gland.

" Dismissing then a congestive stage, the earliest appearance of fatty degeneration of the kidney would of course be recognised by the aid of the microscope, before the gland has undergone any change visible to the naked eye. As the accumulation of fat increases, the kidney becomes granular or 'mottled' on the surface. The smooth mottled kidneys are such as have the greater number of the tubes in the cortical portion almost uniformly gorged; the gland is often much increased in size by the great amount of fat in the tubes, the vessels are much compressed, and the surface of the kidney sometimes presents an almost uniform yellowish-white colour, and here and there a few vessels which have escaped obliteration. These are generally cases which have run a comparatively rapid course. The secreting function of the kidney has become greatly impaired, and death has been the consequence. The kidney which has arrived at this degree of fatty engorgement probably never becomes atrophied.

" The *granular and atrophied*, (Bright's) kidneys are those in which the accumulation of fat takes place less rapidly and uniformly; some convoluted tubes become gorged with fat, forming prominent granulations, and these compressing surrounding parts, produce obliteration of the vessels and atrophy of the tubes; and thus the entire gland gradually wastes and contracts. These are the cases in which the tubes of the pyramids become filled with fat, part of which, perhaps, has been carried into them from above; while part is contained in their own epithelium, which, perhaps, (as has been already suggested,) assumes a more active secretory office in consequence of the wasting of the cortical portion of the gland.* Such is Dr. J.'s account of the various forms of what he considers as " Bright's disease."

* Med. Chirurg. Trans. vol. xxix. page 9.

Dr. Johnson proceeds to remark, "I am well aware that many instances of granular and contracted kidneys are met with, in which the degeneration has been of a totally different kind (from the preceding), and I am also in a position to show, that these are *not cases of true Bright's disease*;" under which name he rightly observes, "diseases totally and essentially different in their nature have been often confounded." As an instance of this confusion of terms we may mention, that Mr. Busk, in the same volume,* maintains "that adhesive inflammation of the *tubuli uriniferi* and venous plexus of the kidney, is by far the most frequent cause of chronic albuminuria, and what is termed granular degeneration of the kidney. (Bright's disease.) And I think," he continues, "that the presence of oil in the *tubuli uriniferi*, though undoubtedly of frequent occurrence, has no direct or necessary influence in the production of albuminuria, for the reason that such an undue secretion of oil by the kidney may exist to a very great extent without any albumen being present in the urine, as may be observed in certain cases of jaundice for instance; and on the other hand, because albuminuria may exist, and all the phenomena of suppressed excretion of urea be produced without any oil being discernable in the *tubuli uriniferi*." Mr. Busk then proceeds to observe, as Dr. Johnson had done in the preceding paper, that the presence of oil in the kidney, "is concomitant with some affection of the liver by which the special function of that gland being impeded, the kidney acts as it were vicariously, and eliminates some of the carbonaceous matter which would have been eliminated by the liver in the form of oil, &c."

We have thus two distinct forms of disease, confounded under the name of "Bright's disease," and distinguished by the presence, among other things, of albumen in the urine. In the recent papers of Mr. Simon, and particularly of Dr. Johnson, already referred to, these two forms of disease are now recognised; and the latter form of disease ascribed, as by Mr. Busk, to inflammation. After the above history of the *acute* forms, the reader will find no difficulty in understanding the subsequent

* Med. Chirurg. Trans. vol. xxix. page 269. "Account of a case of congenital deficiency of one kidney; with granular degeneration of the existing one." By George Busk, Esq.

detailed account of diseases supposed to result from the *chronic* forms of inflammatory action.

Anæmotrophied kidney.—*Chronic desquamative nephritis* of Dr. J.—The following is the account given by Dr. Johnson, of the microscopic phenomena presented by the kidney and urine, in the confirmed stages of anæmotrophied renal disease:—

“On placing thin sections of the kidney under the microscope, some of the tubes are seen to be in precisely the same condition as in a case of acute desquamative nephritis, (the hæmotrophied kidney before described.) They are filled and rendered opaque by an accumulation within them of nucleated cells, differing in no essential respect from the normal epithelium of the kidney; this increase in the number, and this slight alteration in the character, of the epithelial cells, are the result of the elimination by the kidney of mal-assimilated products, which are being continually developed in gouty and intemperate subjects, and which are not normal constituents of the renal secretion.

“There must evidently be a certain limit to the number of the cells which can be formed in any one of the urinary tubes; for although some of the cells escape with the liquid part of the secretion, and so may be seen in the urine, as in a case of acute desquamative nephritis; yet in many of the tubes the cells become so closely packed, that the further formation of cells is impossible; and the process of cell development, and consequently of secretion within that tube, are arrested. The cells thus formed and filling up the tube gradually decay and become more or less disintegrated. While these changes are going on in the convoluted portions of the tubes, the malpighian bodies remain quite healthy, the malpighian capsules for the most part transparent, and the vessels in their interior are perfect. From these vessels water, with some albumen, and coagulable matter is continually being poured into the tubes; and as a consequence of this, the disintegrated epithelial cells are washed out by the current of liquid flowing through the tubes; so that on examining the sedimentary portion of the urine, we find in it cylindrical moulds of the urinary tubes, composed of epithelium in different degrees of disintegration, and rendered coherent by the fibrinous matter which coagulates among its particles. The appearance of these casts are quite characteristic of this form of ‘chronic desquamative nephritis.’”

" There is reason to believe that when the process of cell development and of secretion, have once been arrested by the tube becoming filled with its accumulated contents, it never recovers its lining of normal epithelial cells; but when the disintegrated epithelium has become washed away from the interior of the tube, the basement membrane may be seen in some cases entirely denuded of epithelium; in other cases, a few granular particles of the old decayed epithelium remain; and again in other instances the interior of a tube which has been deprived of its proper glandular epithelium is seen lined by small delicate transparent cells, very similar to those which may be sometimes seen covering the vessels of the malpighian tuft.

" It now becomes interesting to ascertain what further change the tube undergoes after having lost its normal epithelium. It is quite certain that, as a general rule, the malpighian bodies remain unaffected, both in structure and in their office of secreting the watery constituents of the urine, until the whole of the disintegrated epithelium has been washed out of the tubes. Of this there are two proofs; the first is the fact of a very long convoluted tube having its contents completely washed out and its basement membrane left quite naked: this could happen only as a consequence of a current of liquid passing through the tube, and there is no known source of such a current but the malpighian vessels: the second proof is still more convincing and satisfactory, and it is this—that a tube may be often seen entirely denuded of its epithelial lining and continuous with a malpighian body in the interior of which the vessels are quite perfect.

" Now a tube of this kind deprived of its lining of normal epithelium has manifestly lost its power of separating from the blood the solid constituents of the urine; while the malpighian vessels remaining unaffected, the power of secreting water remains. Further it appears probable, not only that the malpighian body continues to secrete water, but that the whole length of a convoluted tube thus deprived of its proper epithelium, and either remaining naked or lined by delicate nucleated cells, such as those which cover the malpighian vessels,—that the entire length of such a tube becomes a secretor of water, which it also abstracts from the portal plexus of vessels on its exterior. This is rendered probable by the appearance of the tube itself; and the probability is still further

increased by the fact of the tubes becoming in some cases dilated into cysts; which usually contain a simple serous fluid, without any of the solid constituents of the urine." *

The subject of scrous-cysts, on which there is a diversity of opinion, will be presently considered. In the meantime we may notice Dr. Johnson's observations, on the further changes taking place in the kidney in the present form of disease. "Another change," says Dr. Johnson, "consequent on the destruction of the cells which line the urinary tubes is a diminished supply of blood and a gradual wasting of the tube. I have already shown that there must be a clear connexion between an increased development of epithelial cells and an increased afflux of blood to the part. This is well seen in a case of acute desquamative nephritis; and *vice versa*, a more or less complete destruction of the epithelial cells will be attended by a corresponding diminished afflux of blood, and a consequent atrophy of the part affected. In every kidney which has been the subject of chronic inflammation, there may be seen tubes contracted in different degrees, as a consequence of the destruction of their epithelial lining; in some instances the basement membrane becomes folded and presents an appearance not very unlike white fibrous tissue. As a consequence of this wasting of successive sets of tubes, there is a gradual diminution in the bulk of the cortical portions of the kidney, until at length the entire organ becomes small, contracted, and granular. When a thin section of a kidney thus atrophied is placed under the microscope, there may be seen an abundance of fibrous tissue, and this has often been described as *new* fibrous tissue developed during the progress of the disease; whereas it is in reality nothing more than the atrophied remains of the basement membrane of the tubes, with the healthy fibrous tissue arranged in the form of a network in which the tubes are packed; and which now appears more abundant in consequence of the wasting of the tubes.

"It has been already stated, that the malpighian bodies are unaffected in the progress of this disease; and this is true in so far as they remain for the most part free from any deposit or accumulation in their interior; but they must necessarily be affected by the changes occurring in other parts of the organ. Thus the destruc-

* Dr. Johnson, Med. Chir. Trans. vol. xxx. p. 174. General series.

tion of many of the malpighian bodies is a necessary consequence of the simultaneous wasting of the vessels and tubes which occurs in the advanced stages of chronic nephritis; and during the progress of the disease the vessels of the malpighian tuft will be in a state of more or less active congestion, in proportion to the rapidity of secretion and of cell-development in the tubes; and one consequence of this congestion of the malpighian bodies will be the escape of serum into the tubes, and the mixture of albuminous matter with the urine. The quantity of albumen in the urine will be great in proportion as the disease approaches in activity to that form which I have called "acute desquamative nephritis." When the disease is chronic and inactive, there may be no albumen in the urine; or it may be present in quantities so small as not to be detected by the ordinary chemical tests. In such cases, as indeed for the accurate discrimination of all forms of renal disease, the microscope will be found an invaluable aid. It must be remembered, that the essential change in this disease is a destruction of the epithelial cells in the manner already described; the best evidence of this change being in progress is the presence in the urine of moulds of the urinary tubes, composed of more or less disintegrated epithelium; and such evidence I have repeatedly obtained when no albumen could be detected by the ordinary heat and nitric acid tests."

Dr. Johnson proceeds to explain the *deficiency of saline matter*, and the *large quantity of urine usually passed in confirmed anaemotrophied diseases*, on the preceding principles.—"With regard to the deficiency of saline matter; it is manifest," he observes, "that if the epithelial cells are the agents by which the solid constituents of the urine are separated from the blood, a deficient excretion of these materials will be a necessary consequence of the greater or less destruction of the epithelial cells." Again with reference to the large quantity of urine,—after alluding to the effects of sugar in the system in diabetes, he continues, "if the presence of the solid irritating constituents in the blood like the sugar in diabetes, be the cause of the large quantity of urine, it is well-known, that as a consequence of renal disease, these materials are retained in the blood in such quantity as to be always injurious and frequently fatal to the patient. If, on the other hand, the malpighian bodies are stimulated to secrete water by the pre-

sence in the tubes of the cells with their solid contents ; it has already been shown that, as a consequence of chronic nephritis, these cells accumulate in the tubes in such abundance, that they may be supposed to excite the malpighian bodies to action ; in a manner not unlike the excitation of the lachrymal gland by a foreign body on the conjunctiva."

In an appendix to his paper, Dr. Johnson gives an account of another form of disease, consisting of a *combination of fatty degeneration of the kidney, with desquamative nephritis.*

Dr. Johnson thus recapitulates ; which allows us likewise the opportunity of recapitulating the leading facts contained in the preceding pages :

"I have now distinguished and observed four conditions of the kidney :—

1. "*Acute desquamative nephritis,*" corresponding with our *acute inflammation of the hæmotrophied kidney.*—In this form of disease, the essential changes in the kidney are an increased fulness of the blood-vessels, and an abundant development of epithelial cells, differing slightly in general appearance, size, and consistence from the normal renal cells.

2. "*Chronic desquamative nephritis,*" corresponding nearly with some of the forms of our *inflammation of the anæmotrophied kidney.*—Here the cells have become so closely packed in many of the tubes, that the further formation of cells, and consequently of secretion within such closely packed tubes are impossible. After a time, the cells become disintegrated, and are washed out by the current of fluid flowing through the tubes, so that on examining the sedimentary portion of the urine, we find in it cylindrical moulds of the urinary tubes, composed of epithelium in different degrees of disintegration, and rendered coherent by the fibrinous matter which coagulates among its particles. These casts are characteristic of this form of disease.

3. "*Simple fatty degeneration,*" occurring both with hæmotrophy and anæmotrophy. In this form of disease, there is simply an accumulation of oil globules in the epithelial cells, which fill and distend the urinary tubules ; but no increase in the number of the epithelial cells, nor inflammatory products of any kind. This form of fatty degeneration of the kidney, occurs in animals as a consequence of confinement

in a dark room, and is decidedly of a *strumous character*. * The earlier stages of this disease are of common occurrence in the human subject; but the more advanced stages are much less common.

4. "*Combination of fatty degeneration with desquamative nephritis.*" †—Here "the convoluted tubes are found filled in different degrees with oil; some tubes being quite free, while others are ruptured by the great accumulation in their interior. The opake yellow spots scattered throughout the kidney, are neither more nor less than convoluted tubes distended, and many of them ruptured, by their accumulated fatty contents; just as the red spots are found to be convoluted tubes filled with blood. The cells which contain the oil, are for the most part smaller, more transparent, and less irregular in their outline than the ordinary healthy epithelium. They are increased in number, and many of them are so distended with oil as to appear quite black. In parts of the same kidney there may be commonly seen some of the appearances already described as indications of desquamative nephritis." This form of disease in its latter stages is of much more frequent occurrence than the simple fatty degeneration of the kidney; and is very commonly combined with fatty degeneration of the liver, though less frequently than the simple fatty degeneration of the kidney." ‡ It comprehends a very numerous class of diseases connected both with haemotrophy as well as with anaemotrophy; and among others, many of those renal affections especially occurring in middle life in strumous subjects, who are at the same time gouty; or liable to other hereditary maladies, more especially involving the assimilating functions.

Each of these four great divisions exist in numerous forms and grades; but besides these, there are many other diseases of the kidneys, as Dr. J. has remarked, accompanied or produced by

* On this point both Mr. Simon and Dr. Johnson quite agree.

† This form of disease is represented by Dr. Bright, in his third plate, fig. 5. Also by Rayer, in his Atlas, plate viii. fig. 1, 2, 5, 6. Both Mr. Simon and Dr. Johnson coincide in the opinion that the mottled kidney never becomes contracted to the same extent as in the extreme anaemotrophied kidney.

‡ Dr. Johnson *ubi supra.*

inflammatory action of these organs; as well perhaps as of an original and idiopathic character; the nature of which at present is but imperfectly understood, and must therefore be left to future inquiries.

There is, however, one point on which I shall make a few remarks before closing this part of our subject, viz., the *cysts* so frequently found in renal diseases.

"Any one," says Mr. Simon, "who has made a dozen *post-mortem* examinations, must have observed cysts in the kidney; and there can be few pathologists who have not speculated on the origin of these growths. Their connexion with chronic obstructive diseases of the kidney being notorious, some observers have supposed them to originate in dilatation of the malpighian capsules; while others have referred them to distension of the urinary tubules. They exhibit great variety in size; they are seen every day as small as mustard-seeds, and they have been seen as large as cocoa-nuts. Thus they obviously range from a very conspicuous largeness, to a size at which the naked eye loses them." On the origin and nature of these cysts, Mr. Simon and Dr. Johnson seem to be at issue. Dr. Johnson supposes these cysts to be "dilatations of the urinary tubes" after these tubes have been denuded of their epithelial lining. In ordinary cases, according to Dr. J., the malpighian bodies connected and continuous with the tubes, are still quite perfect, and continue to secrete water into the tubes, which being closed at their lower ends by a deposit in their interior, or by pressure from without, become dilated into the globular form of cysts. Mr. Simon supposes, like Dr. J., these cysts to be the result of subacute inflammation of the kidney; but maintains that they are "a vesicular transformation of the ultimate structure of the gland;"—that "the copious formation of cells occupies the place of tubes;" and that the interior of these cysts is "organized for secretion into their own cavities, so as at least to withdraw from the blood, if they cannot eliminate from the body, the materials which fill them." In short, Mr. S. contends that these cysts constitute the organization of a new secretory apparatus, intended to compensate for the more or less obliteration of the structure of the kidney.

It is not for me to decide between these different views of the matter; but if I were to give an opinion I should say, that these

cysts appear to me in different instances to have a different origin ; and consequently that both observers may, to a certain extent, be right. I should not have noticed this contested point but for the sake of mentioning a circumstance which I regard as of considerable practical importance ; and which seems to have some relation to the subject.

For many years past, indeed nearly ever since I have attended to the microscopic phenomena presented by the urine, I have noticed an appearance which I have almost invariably found connected with diseases of a very grave character. I have attempted to represent this appearance in plate III*, but being no draftsman, have probably conveyed a very imperfect notion of it to the reader. The appearance consists of small cysts of an oval, or sometimes almost of a spindle shape, adhering to each other by their small ends like a string of beads. I have seen as many as six thus connected in a line, but three or four are more usual ; and frequently, instead of being connected in a single line, they are associated in other ways ; as attempted to be represented in the plate. I have generally found this appearance along with the oxalate of lime, in malignant diseases ; in certain skin diseases connected with confirmed hypochondriasis, or with insanity ; &c. The urine in many of these cases is not serous, nor in other respects indicative of disease of the kidneys ; though it is difficult to suppose that these organs are quite sound. As an instance, I may mention a case that has recently occurred to me.—The patient was a middle-aged gentleman, who laboured under obstinate dyspepsia, accompanied by great flatulence ; disorder of the hepatic system ; irregularity of the pulse, &c., and confirmed hypochondriasis ; but without any organic disease that I could discover. The urine was not serous ; was of a specific gravity between 1·022 and 1·032 ; abounded in a mixture of lithic acid and oxalate of lime crystals ; and contained more numerous and well marked cysts, like those above described, than I remember to have seen. I subsequently learnt from a friend of this gentleman, that his father committed suicide ; and that one of his brothers was insane.

From the not unfrequent occurrence of these cysts in the urine, they must have been often seen, and probably have been described by microscopic observers. I have not however met with any account

conveying to my mind an exact notion of them. With regard to their character,—are they of the nature of those vicarious cysts above alluded to by Mr. Simon, existing in kidneys whose ultimate structure has been destroyed? or are they of parasitic origin? From the absence of other symptoms of organic disease, as well as for many other reasons, the latter opinion is most probable; i. e., these cysts appear to be germs of parasitic origin, which, under favourable circumstances, are capable of being fostered into extraneous growths of a malignant character.

From early attention to the microscope I have been long acquainted with all the more obvious phenomena presented by urinary sediments; as well as with some other phenomena which I have not yet seen noticed. The cysts above described are, as already said, among the phenomena I have never seen noticed by observers; though they may have been described unknown to me.

In the preceding observations on the microscopic phenomena presented by the kidney and urine in renal diseases, I have attempted, without entering on still debatable ground, to present such a practical outline of the established facts, as I hope will be acceptable to the reader. In general, to avoid misrepresentation, I have used the words of the different writers; and I cannot conclude these remarks without expressing the pleasure I feel in the striking illustration and support thus given to the views long advocated in this volume; and in contemplating the fact, that for the greater part of our knowledge on these matters, we are indebted to the labours of our own countrymen.*

* Besides the papers quoted, the reader is referred for further information on the microscopic anatomy and phenomena of the kidney and urine, to the papers of Mr. Bowman, "On the structure and use of the malpighian bodies of the kidney," Philos. Trans. 1842; and to Mr Toynbee's paper "On the intimate structure of the human kidney, and on the changes which its several component parts undergo, in 'Bright's Diseases,'" Med. Chirurg. Trans. vol. xxix., page 303, general series. In these papers, as well as in Mr. Simon's and Dr. Johnson's, the reader will find references to other papers and authors, both British and Foreign.

In finally closing this section, there is yet a point on which I wish to make a few other remarks. Amidst the urgent, and apparently more important symptoms which usually accompany renal diseases, the renal disease itself, the source of all the mischief, is, from its unobtrusive character, too often overlooked. On such occasions, I have more than once had the mortification to be superseded by a practitioner who has disregarded, even despised, the renal disease, and prescribed and acted as if no such disease existed. I do not mean to say that lives have been sacrificed in this way ; but I have certainly seen instances in which the fatal event has been accelerated and rendered inevitable. I make these remarks chiefly with the view of illustrating and again inculcating the maxim—that when kidney disease exists, it should not only be known, but never for a moment be lost sight of; whatever may be the nature of the concomitant affection.

SECTION c.—*Of Lithic Acid.*

THE conditions of the urine, of which derangements of the Lithic Acid principle constitute the leading feature, differ considerably according to the modes in which the Lithic Acid is associated in the secretion. Moreover, the modes in which the Lithic Acid is associated, determines the modes or forms in which it is usually precipitated, so as to form the characteristic sediments to be at present considered. These sediments, in general, assume two distinct forms, viz., the form of *amorphous* and impalpable sediments : and the form of *crystallized* and massive concretions. Further, each of these general forms of sediment is deposited under at least three different modifications : that is to say, the amorphous sediments assume the forms of the *yellow*, the *red*, and the *pink* sediments ; the crystallized, or massive concretions, the forms of *crystallized sand or gravel*, *amorphous concretions*, and *pisiform concretions*.

In a perfectly healthy condition of the urine, this secretion not only remains transparent after cooling, but continues transparent, until it begins to suffer those spontaneous changes incidental to all fluids containing organised matters in solution. From a variety of circumstances, however, affecting the general health in every mode and degree, the urine undergoes certain changes by which the Lithic Acid is rendered incapable of being retained in solution; under these circumstances, when the urine becomes cold, and even sometimes before, the Lithic Acid is deposited, either in a state of combination with ammonia or soda; or nearly pure; and thus forms the two great classes of sediments we have now to consider.

Of Amorphous and Impalpable Sediments.—The amorphous and impalpable Lithic Acid sediments consist in general of the Lithic Acid in combination with ammonia. The *yellow* sediments of this variety consist of the lithate of ammonia tinged more or less by the yellow colouring principle of the urine; the *red* sediments, or *latcritious* sediments, as they are frequently termed, consist of the lithate of ammonia tinged by a mixture of the yellow colouring principle of the urine, and by a peculiar red colouring principle (purpurate of ammonia) developed by the kidneys in certain forms of disease; the *pink* sediments consist of the lithate of ammonia, tinged chiefly by the red colouring principle or principles above alluded to, with little or no admixture of the natural yellow colouring principle of the secretion.

Urine depositing the yellow sediments, like the sediments themselves, ranges through all the shades of colour peculiar to the variety. It is always acid, sometimes acid in a high degree. The quantity and specific gravity also are liable to considerable variety; but are generally confined within the extreme limits of health; that is, the *specific gravity* usually lies between 1·015 and 1·025; and the quantity varies accordingly. Urine depositing the healthy yellow sediments is rarely serous; nor does it present any other remarkable deviation from the normal state.

Urine depositing the *red* sediments is usually more or less of a deep brown or red colour. It is generally more acid than the urine of health; and while the quantity passed in a given time is almost always below the normal standard; the specific gravity as often exceeds, and commonly ranges, between 1·025 and 1·035.

Urine depositing the red sediments is sometimes serous; and not unfrequently presents other anomalous properties, which it would be foreign to our purpose to notice here. The yellow and the red are the most common of urinary sediments.

Urine depositing the *pink* sediments is usually more or less of a red or purplish tint. It is acid, and often passed in considerable quantity. Hence its specific gravity seldom surpasses 1·030, and is often considerably below this point. I do not remember to have seen urine depositing the pink sediments serous; though it may be occasionally so. Pink sediments in a well-marked form are not very common.*

With respect to the *constitutional symptoms* and *causes* accompanying and producing these three varieties of amorphous sediments, it may be observed;

First. The different varieties of *yellow* sediments may be called the *sediments of health*, if such a term be allowable. That is, the different varieties of yellow sediments are such as are produced in the urine of healthy or slightly dyspeptic individuals by errors of diet, atmospheric changes, and numerous other circumstances, which seem, independently of fever, to produce certain derangements of the digestive functions, and a turbid state of the urine. Perhaps there is no healthy individual whose urine does not occasionally deposit this variety of sediment. There are some, however, much more liable to these deposits than others; and such individuals have turbid urine from the slightest causes, more especially during the colder seasons of the year. In instances of this kind, the extremes of the scale of colours may be often noticed at very short intervals; that is to say, the

* During thirty years since urinary diseases have attracted my notice, I have not seen a dozen *well-marked* cases of pink sediment. Even the less strongly-marked cases are not very common. I mention this, because it has been asserted that such sediments are common in hospitals. One of the last specimens of a *well-marked* pink sediment that occurred to me, now several years since, was sent me by Dr. Elliotson; of whom I took the opportunity of inquiring whether such sediments were really common at the hospital to which he belonged. He assured me that they were very rare; and if I remember rightly, that he had not seen more than three or four such instances during the long period of his connexion with hospitals. I have seen only one well marked case of pink sediment since the last edition of this work was printed.

colour of the sediment one day will be pale and almost white ; the next day of a deep yellow, bordering on red. This variety of sediment is very common in the urine of children.

Secondly. The varieties of *red* sediments usually indicate the presence in the system of feverish or inflammatory action ; indeed this law is so general, that I have scarcely seen an exception to it. The deeper the colour of the sediment, and the more approaching to *red*, the more severe in general the inflammatory symptoms. The urine of all persons labouring under feverish and inflammatory affections, and whose urine is naturally healthy, is liable to deposit this variety of sediment. Those, however, whose urine is most liable to deposit the yellow sediments, seem most liable to the paler varieties of the red sediments ; from which the deeper varieties of yellow sediments differ by imperceptible grades only. Such persons appear to be naturally of an irritable feverish habit, and are apt to be affected by the slightest causes ; as by trifling errors in diet, a chilly nature of the atmosphere, &c. They are often subject to gout or rheumatism ; in which diseases, more than in any others, these sediments may be seen in their most strongly marked forms.

Thirdly. The varieties of *pink* sediments usually indicate the presence in the system of certain chronic visceral affections, especially of the liver and spleen. These sediments occur also in hectic or irritative fever ; but in this case they often partake more or less of the character of *red* sediments ; into which, on the one hand, they gradually merge by imperceptible degrees. The most perfect specimens of the pink sediment I have seen, have been unaccompanied by fever ; and have occurred in dropsical cases associated with hepatic disease. In a few cases of obstinate dyspepsia connected with formidable visceral obstruction, I have seen the urine not only passed of a bright pink colour, but remain so on cooling, without depositing any sediment. In these cases the lithate of ammonia appeared to be absent, and the colouring matter in consequence remained in solution.

After what has been stated, we need not enter on the subjects of *diagnosis* and *prognosis*, with reference to these sediments. Moreover, as these sediments are, for the most part, symptomatic only of other diseases, and rarely or never of themselves give occasion to secondary complaints, we are scarcely called upon to

consider their mode of treatment. Hence the little we have to say on this part of the subject will be deferred till we come to speak of the treatment of the lithic acid diathesis in general. We pass on, therefore, to consider the second general form of lithic acid sediments, viz. *crystallized or massive sediments*. Massive sediments composed of the Lithic Acid appear, as we have stated, under at least three distinct forms, viz. *crystallized sand or gravel*; *amorphous concretions*; and *pisiform concretions*; on each of which we shall make a few remarks.

Crystallized Sediments, or *Red Gravel*, consist of Lithic Acid nearly pure. Lithic acid, as has been before stated, exists in healthy urine, in such a state of combination, and in such a proportion, as to be held in solution at all ordinary temperatures. In certain conditions of the system, however, the constituent principles of the urine are so arranged that the lithic acid is precipitated from that secretion in a crystallized and nearly pure state —a phenomenon easily imitated artificially, as is well known, by the addition of a few drops of any acid to healthy urine. The precipitation of crystallized lithic acid does not, therefore, necessarily indicate an *excess* of lithic acid in the urine, but only the peculiar arrangements of the urinary principles above mentioned; and so completely is the urine divested of lithic acid by this peculiar arrangement, that on adding to it an excess of a mineral acid, not another particle of lithic acid is usually deposited. Crystallized sediments vary considerably in their colour and appearance according to circumstances. When unaccompanied by fever, their colour is usually identical with the deeper tints of the yellow amorphous sediments above described. When they are accompanied by fever, they are generally more or less of a red or intertious colour. I have never seen crystallized sediments of a *pink* colour; but I have seen them of so dark a shade of brown or red, as to appear, at first sight, almost black.

The urine depositing the yellow crystallized gravel is commonly more transparent than usual, and of a peculiar copper colour. It is always acid, sometimes in a preternatural degree. The quantity voided is often considerable; and in this case the specific gravity is seldom much above 1.020. At other times the quantity is less, and the specific gravity considerably higher.

Urine depositing the red crystallized gravel is commonly

transparent, of a deep red or brown colour, and strongly acid. The quantity passed in a given time is generally below the average, and hence its specific gravity almost always exceeds that of health. Between these two extremes, the colour and other properties of the urine, above described, like the analogous properties of the crystallized gravel, vary in every possible degree.

Amorphous Lithic Concretions are generally deposited in the kidneys, and, more frequently than any other cause, give occasion to that peculiar train of symptoms constituting a nephritic attack, to be hereafter described. They may be considered as of two kinds, the coloured and the white. The coloured varieties are by far the most common. They vary in size, from that of a pin's head to that of an almond. Their form is irregular, but generally elongated. The surface is usually rough; and the texture of their central parts, at least, is neither crystallized nor lamellated, but presents the appearance of being formed from a number of irregular smaller masses agglutinated together. Their colour varies considerably, being sometimes of a bright yellow; at other times of a dark brownish red; in other instances, they present externally a whitish appearance, at least in their dry state. All these varieties consist of the lithic acid nearly pure; and tinged only with the colouring matters of the urine. The white varieties, which are very rare, consist chiefly of the lithate of soda. They are of various sizes and shapes, and are usually soft and friable. Their texture is amorphous, never crystallized; and they have often the appearance of having been moulded, while in a plastic state, into the forms they present.

The urine accompanying the coloured varieties of the lithic acid concretions differs but little from the state it presents, when it deposits the lithic acid gravel before mentioned. Indeed, crystallized gravel, as well as amorphous sediments, often alternate with, or accompany, the formation of the yellow varieties of amorphous lithic concretions now under consideration. Such crystallized gravel or amorphous sediments, however, appear more especially at those periods when there is a greater than ordinary tendency in the system to form lithic acid; on which occasions the urine is generally deep coloured, scanty, of high specific gravity, and strongly acid. On the contrary, the urine in the few cases I have seen of the white lithate of soda concretions, has

been of a pale whey-like colour, copious, of low specific gravity, and occasionally serous.

Of Pisiform Lithic Concretions.—The primary nucleus of this form of concretion is usually formed in the kidney; though for the most part the concretion descends into the bladder before it has acquired such a magnitude as to give uneasiness, either in the kidney, or during its passage down the ureter. A remarkable feature attending the formation of this variety of concretion, is the *great number* in which they are usually generated; a circumstance which may be said to be characteristic of them. Their great number occasions them to accumulate occasionally in the pelvis of the kidney; or in the lower portions of the ureters, where these canals terminate in the cavity of the bladder; and on such occasions severe nephritic attacks are sometimes the consequence. These concretions vary in size, from that of a pin's head to that of a pea or marble. Their form is always more or less globular; though they sometimes present flattened or faceted surfaces, produced by their contact or attrition with each other. Their surface is usually smooth, sometimes even porcelainous or polished; and their internal texture is almost invariably crystallized, and usually lamellated. Their colour ranges through all the shades of yellow; and occasionally, though more rarely, they assume a dark brown or reddish colour.

The urine, in this form of concretion, approaches in its properties the state of the urine which deposits the lithic acid gravel; that is to say, it is usually transparent, of a light yellow colour, distinctly acid, rather copious, and of moderate specific gravity.* Yet it is remarkable that this form of urine rarely deposits crystallized gravel or amorphous sediments; and in the few instances in which these sediments occur, they usually belong to the yellow, rather than to the red varieties.

The *symptoms* local and constitutional accompanying the deposition of lithic acid in the massive condition from the urine, are

* The urine, in this form of lithic acid concretion, as well as in the amorphous form of concretion, is frequently of low specific gravity, perfectly transparent, and *strongly serous*; particularly in those who have been accustomed to the daily use of large doses of strong wines; and who are at the same time of a gouty habit. See Hæmotrophy of the Kidney in the preceding section.

more or less of pain or uneasiness in the region of the kidneys ; with irritation and sense of heat about the neck of the bladder and urethra. There is always a frequent desire to pass the urine, which is voided in small quantities at a time, and without affording the usual relief ; the sensation still continuing of something being left behind in the bladder. The digestive functions also, as in most cases where urinary deposits are concerned, are considerably deranged, or very liable to become so ; and the patient is frequently troubled with acidity of the stomach, flatulence, &c., particularly after any little error in diet ; as the use of fruits, acescent wines, &c. We have seen, however, that massive lithic sediments assume very different forms ; and we may remark that these different forms of massive lithic sediment, are not only associated with very different periods of life, but with very different constitutional symptoms and consequences. We shall consider the subject, therefore, with reference to four periods of life ; viz. before puberty ; between puberty and the age of forty ; between forty and sixty ; and in old age.

Children in general, and particularly the children of dyspeptic and gouty individuals, or who inherit a tendency to urinary affections, are exceedingly liable to crystallized lithic deposits from the urine. These appear not only under the form of amorphous sediments as before mentioned, when there is seldom much irritation in the urinary organs ; but frequently also in the form of crystallized gravel. In this case, symptoms of irritation about the urinary organs may be always more or less observed, if the child be attended to. Thus there will be found to be a frequent desire to pass urine, which is voided in very small quantities, and with manifest uneasiness. The irritation about the urinary organs also sometimes induces the child to wet the bed by night, &c. In such instances, if the urine be examined, it will always be found to be very unnatural, and frequently loaded with lithic acid ; and should this prove to be the case, the matter requires immediate attention, as there is much greater risk at this period of life than any other, of the formation of stone in the bladder ; as will be more particularly shown hereafter.

Between the age of puberty and forty, there is, perhaps, generally speaking, less disposition to the formation of lithic acid deposits than at any other period of life. In individuals, however,

who have a strong disposition to urinary affections, these sediments not only frequently occur even during this period, but go on almost constantly in some form or other, and in different degrees, according to circumstances. Except, however, in extreme cases, the lithic acid appears in the form of crystallized gravel only; and hence the secondary symptoms of irritation in the urinary organs, &c., are by no means severe, and consequently attract but little of the patient's attention; more especially as his health, however paradoxical it may appear, will be generally found to be in a better state than ordinary, at those periods when lithic acid gravel is deposited in the urine. Partly for the reasons stated, and partly from other circumstances to be noticed hereafter, there is less risk, at this period of life, of the formation of calculi than at any other; and consequently this occurrence seldom takes place, except by accident; or when there is more than ordinary disposition to the disease.

About the age of forty an important change commonly takes place in the constitution, which for the most part materially influences the deposition of lithic acid from the urine. It will now be generally found, that the lithic acid is apt to be deposited at intervals in larger quantities than usual; and that for some time previously to this occurrence, there is more or less of feverish indisposition and derangement of the general health. About this period of life, also, there is a tendency in the constitution, under the above (haemotrophic) circumstances particularly, to separate the lithic acid in a concrete state; and thus to give origin to the formation of renal calculus, and the consequent train of secondary symptoms, to be detailed when we come to speak particularly of that circumstance. Such occurrences are most liable to take place in those individuals who have all their lives been subject to lithic acid deposits; but they not unfrequently occur also at the period of life we are considering, in those who have never previously suffered from these affections; but who have lived luxuriously and indolently; or who inherit a tendency to gout, though they have never, perhaps, had an open attack of that disease.

About this period of life, or later, we occasionally see, in certain modifications of gouty constitution, large quantities of the lithate of soda, perfectly white, deposited in the urine. This compound sometimes assumes the form of an amorphous sediment,

and renders the urine quite milky when passed; but I have seen it copiously secreted of the consistence of mortar, especially during the night; and in this case it is apt to collect into masses and block up the urethra, so as to occasion considerable difficulty in passing the urine. Such instances are very rare, and appear to be associated with organic disease of the kidneys, and, perhaps, of other organs.

The above state of things will continue, or at least occur, till old age; but frequently about the age of sixty or seventy, sometimes before, another change takes place in the mode in which the lithic acid is separated from the system. At this period of life, the urinary organs not only begin to participate in the general decay of the constitution, but are apt to be deranged from other causes; and more particularly to suffer from the delinquencies of early life. Frequently, also, they become organically diseased; and this, in conjunction perhaps with other causes that will be hereafter noticed, produces a disposition in the system to secrete neutral urine, or even the earthy phosphates. Under these circumstances, when the urine has previously for years deposited the lithic acid, chiefly in the state of crystals, the crystals will in a great measure disappear; and instead, minute globules of lithic acid of various sizes will be separated from the kidneys in great abundance. In most of these cases there is a good deal of pain in the back, and irritation about the urinary organs; even when the concretions are only of small size. In other instances, there is much less irritation than one would imagine. In all instances, however, this may be considered as a dangerous state of disease, not only on account of the constant liability of the patient to the formation of renal or vesical calculi, which everything conspires to render probable; but on the other hand, on account of the danger there is of suddenly checking, by any means, the secretion of lithic acid; which is apt to be followed by great derangement of the general health. Thus, I have witnessed, under these circumstances, affections of the heart, accompanied by symptoms of *angina pectoris*, take place. The most frequent serious affection, however, which usually follows suppression of the lithic acid, is apoplexy, or other affections of the brain.

On taking a review of what has been stated, it will be seen—

that the earlier periods of life are marked by the deposition of the amorphous sediments and crystallized gravel; that, about the middle period of life, the lithic acid begins to assume the amorphous concrete form, and to give occasion to the formation of renal and vesical calculi; and lastly, that in more advanced age, there is occasionally a tendency to form numerous small calculi by the deposition of lithic acid round minute nuclei; which small calculi differ both in their appearance and structure from those secreted about the middle period of life. Now, though many exceptions occur to these remarks, it may be stated, that they very generally hold good; so that a person accustomed to observe on such subjects, can in most instances readily determine the age, as well as the general symptoms of his patient from the characters of the calculi passed by him.

We come now to make a few remarks on the pathology of lithic acid deposits; under which head will be included general remarks on their *causes*, *diagnosis*, and *prognosis*.

The *causes* giving origin to lithic acid sediments, may, like those producing most other derangements, be considered as of two kinds, *predisposing* and *exciting*. With respect to predisposing causes, there cannot, I think, be any doubt that certain individuals are much more liable to these sediments than others. This tendency, like the tendency to urinary diseases in general, is not unfrequently inherited. Thus, I have repeatedly seen the children and grandchildren of individuals who had suffered from lithic acid concretions, liable to the same depositions. As before observed, the children of gouty individuals, who have never themselves had gout in an open form, are exceedingly liable to lithic acid sediments. In certain modifications of the strumous diathesis also, indicated by a general haemotrophy of the system, in which the solids are of a loose and flabby texture, the deposition of lithic acid is very common. Indeed, this modification of the strumous diathesis, when associated with gout, as is often the case, is, perhaps, more than any other condition of the system, liable to lithic acid deposits. Such associated diatheses are not unfrequently displayed in the form of cutaneous disease; and it is an old remark, that certain forms of cutaneous disease are often accompanied by a deposition of lithic acid. Thus, Sir Gilbert Blane observes, that he has frequently noticed calculous disorders

connected with those impetiginous affections, incident to what is called a *scorbutic* habit ; and which usually depends on hereditary constitution.* I had made this remark long before I was aware that it had been noticed by others ; and indeed I have no doubt of the frequent connexion between the two forms of disease. A late eminent writer, however, seems to call the opinion in question.† After all, perhaps, the differences thus expressed, are more apparent than real, and may be easily reconciled ; for I have noticed in such cases, that when the cutaneous affections are most troublesome, the kidneys generally perform their functions most satisfactorily ; while, on the contrary, when there are copious deposites in the urine, the cutaneous affection disappears. Hence a casual observer, who did not know or inquire into the history of the patient, would not be likely to detect any connexion between the two forms of disease.

The causes more immediately exciting or producing a deposition of the lithic acid sediments in the urine, especially in the predisposed, may be classed under the three heads of *diet*, *exercise*, and *atmospheric influences*.

Errors of *diet* may consist either in simple *excess* of the usual wholesome articles of food ; or in the partaking of food which is *unwholesome*, or which uniformly disagrees with an individual. With respect to an *excess* of wholesome food, it may be observed, that all other circumstances being the same, an unusually heavy meal, especially of animal food, or of bread, is almost invariably followed by a deposition of lithic acid from the urine in some form or other ; the same may be said of mixtures of animal and farinaceous matters ; or, from the quantity of azote it contains, of any articles made of wheaten flour alone ; but those who live chiefly on matters purely farinaceous, or free from azote, are little liable to lithic acid deposites. With respect to the *unwholesomeness* of food, so much depends on custom and idiosyncrasy, that this point can be hardly determined, in many instances, except by observation and experiment. Whatever agrees with the stomach of an individual, when taken in moderate quantity, may, perhaps, be pre-

* See "An Essay on the Effect of Pure Alkalies in various Complaints," in a work entitled, "Select Dissertations on Several Subjects of Medical Science." By Sir Gilbert Blane, Bart. Page 203.

† Rayer, *Traité des Maladies des Reins, &c.* Vol. i. page 55.

sumed to be easily digested, and therefore wholesome as far as regards that individual ; and the stomachs of individuals are, by custom and idiosyncrasy, rendered so various and capricious in this respect, that there is scarcely any kind of food but some stomach may be found capable of digesting it. Certain substances, however, are universally acknowledged to be more difficult of digestion than others ; and among these, perhaps, none surpass the compounds above alluded to, made of wheaten flour ; such as heavy unfermented bread, and compact, hard-boiled, fat dumplings or puddings, all of which, and many others of the same kind, I have observed to be particularly liable to produce lithic acid deposits in the urine.

With respect to *drinks*, it may be observed generally, that malt liquors, particularly when both sweet and acescent, rank among the most powerful in producing lithic acid deposits ; such are most of the strong and pale ales ; porter, and other malt liquors made of scorched malt, have, probably, when acid, a similar effect ; though certainly in a less degree. Similar remarks extend to wines. The strong and sweet wines, which by keeping usually become more or less acid, act very similarly to malt liquors ; while the drier species, even when acescent, though they may act unfavourably on some individuals, are certainly on the whole much less liable to produce lithic acid deposits than might be expected. In such cases, perhaps, a good deal depends on the nature of the acid existing in the liquors ; I have reason to believe, that the lactic, acetic, and oxalic acids, act much more unfavourably on the stomach than the malic, tartaric, or citric acids. Lastly, with respect to *waters*, it may be observed, that hard and impure waters possess great influence in urinary diseases and deposits ; an old opinion, of the truth of which I am constantly reminded by experience. They operate in various ways, and produce very different effects in different diseases and constitutions ; but their general influence in all forms of urinary deposition is, according to my observation, very unfavourable.

Exercise, in every form and degree, so taken as to interfere with the assimilating processes, as, for instance, immediately after a meal, &c., is, other things being the same, very apt to promote the formation of lithic sediments. Various exercises, affecting in particular the dorsal system, such as riding on horseback, have been

observed to produce urinary deposites in those who have been unaccustomed to such exercise ; these effects, however, are generally transient, and cease alike, either by the repetition, or by the cessation, of the exciting cause. On the contrary, the *want of exercise*, after a certain stage of the digestive process has been completed, is usually followed by the same consequences. Indeed, bodily inactivity, conjoined with a full or improper diet ranks among the most fertile and powerful causes of such deposites ; and however healthy and strong the individual may be, if he persists in such habits, he will be almost certain, sooner or later, to suffer from their consequences ; either in the form of urinary deposites or of gout.

Under the head of *atmospheric influences*, we include cold and moisture, and all the external circumstances peculiar to particular districts or localities. Cold and moisture alone, independently of other causes, appear to exert considerable power in causing turbid conditions of the urine ; as every one must have noticed who has paid the least attention to the subject in our variable climate. The effects of cold and moisture are, however, much more remarkably striking when they concur with the other exciting causes mentioned, viz., errors of diet, complete bodily inactivity, &c. In a warm and dry state of the atmosphere, where cutaneous exhalation is active, such slight causes often scarcely affect the urine ; but in cold and damp weather they are sure to be followed, even in the most healthy, by a deposition of the alkaline lithiates. Malarious influence in warm climates does not seem to lead to lithic deposites ; but in cold climates, where it operates more especially by inducing rheumatism and ague, it may be considered, especially when concurring with other causes, as a fertile source of such depositions.

To these exciting or external causes, a variety of others may be added, having no principle in common, except, perhaps, that of deranging the assimilating processes, and of diminishing the vital energies. Such are depressing passions of the mind ; inordinate bodily or mental fatigue ; long fasting, &c. ; all of which, and many besides, especially when they concur with the other causes mentioned, are apt to produce turbidity of the urine. With respect to the operation of these causes in general, it is only necessary to remind the reader, in conclusion, that although the exciting causes

enumerated exert certain influences under all circumstances, yet that their effects are considerably modified by the operation of the predisposing causes. Thus, in young children, the exciting causes most frequently produce a tendency to lithic acid amorphous sediments, and gravel; in young adults, to amorphous sediments; in middle-aged individuals, to amorphous sediments and concretions; in old age, to pisiform concretions, &c. Hence, to enable us to form a correct estimate of the operation of causes, we must take into account the effects of those which predispose to, as well as those which immediately excite, disease.

What may be considered in one point of view as the *proximate* cause of lithic acid deposits, and their intimate pathological relations, may be thus briefly-stated :

The lithic acid and its compounds we suppose to be principally derived from the albuminous principles, not only of the chyle and blood, but also of the albuminous textures of the body; in the same sense and modes in which we supposed urea and lactic acid to be principally derived from the gelatinous textures. When, on account of the imperfect assimilation of alimentary matters by the stomach and primary assimilating processes, the chylous principles are not raised to that standard of perfection by which they are fitted to become component parts of the blood; we suppose that the healthy kidney possesses the power of selecting and disorganizing such imperfectly developed chylous matters, and of converting them into the lithate of ammonia. Such is the presumed origin of most of the common *yellow* amorphous sediments occurring to healthy individuals from slight errors in diet, &c.

During feverish or other derangements, in which the functions of the hepatic system are particularly involved, the lithate of ammonia is not only supposed to be derived from the imperfectly assimilated chyle, and the deteriorated albuminous principles of the blood; but also from the deranged secondary assimilation of the albuminous textures of the body. The lithate of ammonia thus developed, appears in the urine more especially under the forms of the red and pink amorphous sediments; and is distinguished by the large quantities of colouring matters developed in conjunction with it. Lastly, the massive forms of lithic acid deposits are derived from the same sources as the above; but when thus de-

posited, the lithic acid is secreted, either in connexion with acids, which, by combining with the ammonia of the lithates, set the lithic acid free ; or in connexion with other bases, as soda, &c., the compounds of lithic acid with which are less soluble than the lithate of ammonia.

With regard to the general pathological relations of lithic acid and its compounds; we may remark, that as the lactic acid developed principally during the secondary mal-assimilation of the gelatinous textures was considered as the characteristic feature in rheumatism ; so the lithic acid developed principally during the mal-assimilation of the albuminous textures; may be considered as the characteristic feature in gout. Moreover, when the lactic and lithic acids are developed together, as they may be, and often are, the phenomena may be supposed to show that the mal-assimilation involves both the gelatinous and albuminous textures ; and that the accompanying disease partakes of a mixed character ; or in fact constitutes what is not improperly termed *rheumatic gout*—a form of disease, which every one knows, is usually of a much more deep-seated and obstinate character than either gout or rheumatism alone. According, therefore, to these views, the lactic and lithic acids, considered with reference to rheumatism and gout, may be regarded somewhat in the light of *materies morborum*; or, strictly speaking, the undue presence of these acids in the urine or elsewhere, under certain circumstances, may be viewed as indices of the existence of certain diseased actions going on in the primary tissues of the body ; and which are known by the names of rheumatism and gout.

I do not think it worth while to illustrate these views further, much less to enter into a formal defence of them ; but shall merely observe, that those who will take the pains to understand them, and to study the phenomena presented by rheumatism, gout, and other allied diseases, will find that these views are neither altogether groundless nor useless ; but that they will often furnish a clue to diseased operations, which would be sought for in vain through any other channel.

As further illustrations of the general pathological relations of lithic acid deposits in the urine, I shall briefly notice three very important forms of disease in which this phenomenon occasionally occurs. The two first of the instances to be mentioned may be

viewed in some respects as the extremes of their respective classes ; and consequently as including a great variety of similar affections in various states of combination, as well as of inferior degree. The third instance, by establishing the connexion between the deposition of lithic acid and diabetes, throws considerable light on the pathology of both affections.

Whoever has much attended to urinary diseases, must have remarked that many individuals subject to derangements of the general health, seldom feel so well with respect to their health, as when lithic acid deposits take place in the urine. This circumstance is, perhaps, most strikingly exemplified by those attacks of gravel which are apt to commence about the middle period of life in gouty individuals. Thus, we frequently find that patients, who had previously for months, or even for years, been subject to various anomalous affections and pains in different parts of the body, accompanied by great derangements of the assimilating functions, will suddenly obtain relief from the whole by a discharge of lithic acid gravel, or perhaps of a small lithic acid calculus from the kidney. Now, although it would be absurd to consider the lithic acid in such cases as the real *materies morbi*, yet in many instances we may *practically* proceed on such a supposition ; as will be shown hereafter. In this class of diseases, therefore, the appearance of lithic acid in the urine may be considered in a favourable point of view. In the following classes of disease, the indications afforded by the deposition of lithic acid in the urine are often far different. Individuals, whose general health has been impaired from a long residence in hot climates, and who in particular have suffered from hepatic disease, are often very subject to lithic acid deposits, particularly during the winter months ; and in such instances the right kidney is much more frequently the immediate seat of the inconvenience than the left. Again, those who have suffered in early life from injury of the back and kidneys, by falls, &c., are often very liable to lithic acid deposits about the middle period of life ; particularly if they inherit a gouty constitution. Another class of sufferers from the same depositions are middle-aged females, who have laboured (or who are about to labour) under chronic uterine disorders ; particularly of the malignant kind. I have said *about* to labour ; for in most of the cases of this kind which have fallen under my notice, there has ap-

peared to be diseased action going on in the uterus, and affecting the neighbouring viscera, which had not yet showed itself openly ; at least not in its most alarming forms. Now, when the deposition of lithic acid thus appears about the middle period of life, for the first time, in broken-down constitutions and unhealthy subjects, so far from bringing relief or indicating a favourable result, as in the first class of affections above stated, such deposition is not unfrequently the sure forerunner of a general breaking up of the system, and of a speedy dissolution ; of which I have seen a great many instances. Intimately connected with the two preceding instances, yet differing in some degree from both, is the third point we have to mention ; viz. the connexion of lithic acid with diabetes. When speaking of diabetes, we stated that in certain cases of this disease, lithic acid occasionally appears in the urine ; and that the circumstance, as far as regards the diabetes, is rather of a favourable character. When, however, the deposition of lithic acid is the prominent disease, and saccharine matter appears only occasionally in the urine, the circumstance is anything but favourable ; for the combination not only indicates deep-seated derangement of the assimilating organs, as regards the albuminous principle ; but also as regards the still more important and fundamental saccharine principle. Such a combination is by no means unusual in corpulent middle-aged individuals of a gouty strumous habit ; and is always to be viewed with some degree of anxiety. I have generally noticed that such individuals die of some sudden and overwhelming attack of internal inflammation, rapidly assuming the adynamic form ; or of apoplexy. They seem, also, to be subject to the severer forms of erysipelas ; and to diffuse inflammation in general of the cellular tissue. Indeed, the greater number of instances of fatal diffuse inflammation, arising either spontaneously, or from simple innocuous punctured wounds, which have fallen under my notice, have happened in individuals, whose urine occasionally contained sugar, as well as deposited lithic acid gravel. Lastly, it may be well to remind the reader that the tendency of lithic acid deposits is almost invariably connected with an hæmotrophied condition of the kidneys.*

* See page 144, et passim.

The *diagnosis* in lithic acid deposits is sufficiently marked by the *chemical* character of the sediments. The *prognosis*, also, after what has been stated, scarcely needs to be formally discussed ; it will be sufficient, therefore, to remind the reader of a few of the leading points. First, with regard to amorphous sediments, it may be observed—that they are of a less favourable character, in the proportion as they are whiter, or of a more pure pink colour. When pale-coloured, they denote, in general, a tendency to the phosphates ; when of a pink colour, generally some organic or deeply-seated disease. In drawing our conclusions, however, respecting these sediments, other circumstances must at the same time be taken into account ; and particularly the more or less constant deposition ; and the greater or less quantity of these sediments. A constant deposition of amorphous sediments in large quantity will almost certainly, sooner or later, end in an attack of gravel or calculus, or some other mischief : the occasional deposition of the sediments in small quantities is seldom attended with much danger.

Nearly the same remarks may be made with respect to lithic acid gravel. Generally speaking, except a calculus already exists in the kidney or bladder, the appearance of lithic acid gravel is not dangerous, *as long as it is not deposited while the urine is warm*. When deposited in very large quantity ; or in a state disposed to concrete together ; there is a great risk of the formation of calculus. The deposition of lithic acid by gouty and rheumatic individuals about the middle period of life, is often accompanied by relief to the system ; while, on the contrary, in broken-down and diseased habits, it is as frequently the forerunner of a general decay, and speedy dissolution. Lastly, it may be mentioned, that of lithic acid concretions, the pisiform, for the reasons stated, is the most dangerous variety.

Treatment.—We come now to consider the means by which the lithic acid diathesis is to be best counteracted, and its distressing consequences prevented.

Amorphous Sediments.—The first or yellow species of amorphous sediment is not, in general, accompanied by any prominent symptom ; and fever, in particular, is altogether absent, or very slight. Hence this variety of sediment scarcely requires a formal treatment with medicine ; but a careful attention on the part of

the patient to avoid all those circumstances which have a tendency to aggravate the disease.

Of these circumstances errors in diet, from their being most liable to be constant, are of the chief importance; and the error of *quantity* in diet is of infinitely more importance than the error of quality. Any stomach may digest a *little* of anything; but no stomach can digest a *great deal* of anything. This is a maxim that ought to be universally borne in mind where diet is concerned; and, in particular, is of the very first consequence in the present diseases. I do not mean that individuals subject to these affections should indulge themselves with a little of whatever comes in their way; such a license, from the modes in which the term a *little* would be construed by different individuals, would be exceedingly dangerous; on the contrary, they should abstain altogether from things which manifestly disagree with them, and which must be unwholesome to all; such as heavy and imperfectly, or over-fermented bread; hard-boiled and fat puddings; salted and dried meats; acescent fruits; and (if the converting powers of the stomach be much debilitated) from soups of every kind, &c. In general, also, malt liquors and wines, particularly when of an acescent quality, should be avoided. Simple attention to these rules with respect to diet and exercise; the ensuring a due performance of the cutaneous functions by wearing flannel, particularly about the loins; the preserving a regular state of the bowels; and perhaps the occasional use of alterative medicines, are all that are commonly requisite in this form of the complaint; and will scarcely ever fail to prevent its terminating in serious consequences.

When these sediments are very pale-coloured, and liable to be produced by the slightest causes, as trifling errors of diet, a chilly state of the atmosphere, &c., they commonly denote, as before observed, a feverish irritability of the system bordering on that which accompanies the phosphates. In this state they are more dangerous, and require a kind of treatment to be hereafter more particularly described, when we come to speak of the phosphatic diathesis.

The second variety of amorphous lithic sediment is common to many diseases, accompanied by inflammatory action and phlogistic fever; but more especially to certain modifications of gout and

rheumatism. Of course, therefore, the general treatment must correspond with this state of the system, while the particular treatment will depend on the peculiar character of the inflammatory disease; or on the organ particularly affected. The same is true of the third variety; in which the fever, though very different from phlogistic fever in its character, may yet be produced by affections situated in various organs. These circumstances, of course, render it difficult, as well as unnecessary, to be more particular in this place respecting the mode of treatment.

The following are the principles to be kept in view in the treatment of lithic acid deposites in general, whether of the pulverulent or massive kinds. The details of course will require to be varied in *individual* cases according to the circumstances of the patient; but these may be fairly left to the judgment of the practitioner.

The point first claiming our particular attention in the treatment of lithic acid deposites, is *diet* and *regimen*—a subject of so much importance, that if it be neglected, all other means are of little avail. In discussing this subject, we shall commence with the *questio vexata*; whether an animal or a vegetable diet be most appropriate in lithic acid deposites? On this point we need not say there has been much difference of opinion. The philosopher, arguing from the known resemblance and analogy between the composition of lithic acid and albuminous matters, has contended that animal matters should be avoided by those who are subject to lithic acid deposites. On the other hand, the mere practical physician, judging from his experience alone, of the effects of crude vegetable matters in producing lithic acid deposites in certain individuals, has as strenuously contended for the adoption of an animal diet. As is usual in most disputes, the truth lies between the two opinions; both of which have been formed on exclusive and hasty grounds. That is, in neither case has the influence of *quantity* and *custom* as regards diet been taken into account; on which more frequently depends than upon any other cause whatever.

We have already stated, that with reference to diet, *quantity* is often of infinitely greater importance than quality. Thus a *full meal*, whether of animal or vegetable matters, or of a mixture of the two, will usually produce a deposition of gravel in predisposed

individuals, in whom a *spare meal* of the very same materials is not followed by such deposits. There are, however, many individuals, with weak stomachs and strong gouty predisposition, in whom certain articles of food to which they have been unaccustomed, in almost any quantity and without apparent reference to their vegetable or animal origin, will prove of difficult reduction, and produce a deposition of lithic acid. Thus, among animal matters, salted and dried meats, or veal, will often act in this way; while among vegetable matters, potatoes more especially, or the least quantity of any of the subacid fruits, &c., will produce a similar effect. In both these classes of cases, the distinction between animal and vegetable matters is probably quite out of the question; and the deposition of lithic acid in the first class depends on the mere *quantity* of matters taken; which matters may, or may not, furnish the elements from which the lithic acid is elaborated; while in the other class of instances, the deposition of lithic acid depends on the increased acidity produced in the stomach, &c., by the *qualities*, and particularly by the difficult solubility of the matters taken; and the elements of the lithic acid are not derived immediately from the food, but from the proximate principles of the blood. Similar remarks may be made with respect to wines and other fermented liquors. Thus individuals who have been long accustomed to the strong brandied wines generally employed in this country, are almost sure to bring on attacks of pain in the back and gravel by the occasional use of weak acescent wines; such as the inferior hocks, champagnes, &c., particularly in cold climates; and if they are gouty, and subject to urinary deposits. On the contrary, individuals who have all their lives been accustomed to the use of such weak wines; and to the free use of cider; or of perry; rarely suffer from gravel. Malt liquors of every kind operate unfavourably in lithic acid deposits; and the sweet, and the acescent in particular, are perhaps among the very worst articles that can be chosen. Of the diluents in common use, weak tea appears to be the least objectionable. Coffee, particularly if strong, and the heavier fluids, chocolate, &c., should be shunned altogether. Milk in large quantity usually acts unfavourably; and the unfavourable operation of all these and similar articles is much increased by being combined with sugar. To this head may be

referred also the subject of *waters*. Hard waters should in all instances be avoided, by those who are subject to the lithic acid deposites. Such, for instance, are most of the pump waters in and about London, and in chalky districts in general. The Thames and the New River water boiled and filtered are unobjectionable; as are most of the waters in this neighbourhood, which come from a great depth; and are obtained by the new process of boring. Indeed, I have known the water from Artesian wells, probably from its containing a little carbonated alkali, agree remarkably well in lithic acid deposites; and sometimes give ease, even when lithic calculi existed in the bladder, after other means had failed.

The general inferences then from these remarks on diet and drinks are, that in all instances the strictest attention to *quantity* is requisite; and that the patient should never take more of anything than he can fairly assimilate. While, in reference to the *qualities* of alimentary matters, the habits and peculiarities of countries or of individuals must be carefully considered, and the alimentary matters must be adjusted accordingly;—there being in fact no one plan of diet, &c., that will prove to be universally applicable to all places and persons. In this country, generally speaking, a light diet, consisting chiefly of animal and farinaceous matters, will be found most appropriate; while if fermented liquors be employed at all, dilute spirits and water, or the more generous wines, should be chosen in preference. Crude and indigestible vegetable matters, and the use of sweet or acescent wines or other fluids, should be carefully avoided; as should the use of hard waters. Indeed, in every climate and case, the employment of the purest water is indispensably requisite.

In connexion with this part of the subject, it remains to make a few remarks on *exercise*. A due proportion of exercise is proper, and even necessary, in every form of lithic acid deposites; as nothing is so liable to induce and to foster these complaints as inactivity and indolence. The degree of exercise must in a great measure be determined by the circumstances of the patient; and in no instance ought it to be carried so far as to induce fatigue; or, when massive concretions are present, to cause the risk of haemorrhage or inflammatory action in the kidney or bladder. Of the kinds of exercise it may be stated, that under almost all cir-

cumstances walking will be proper. In particular cases, horse exercise has many advantages. Next to horse exercise, is riding in carriages. Carriage exercise, however, often excites the irritable organs, without imparting that benefit to the system, which muscular motion alone can give. On the whole, therefore, if the patient has the use of his limbs, walking, constitutes the best form of exercise.

It is more especially in lithic acid deposits that *alkalies* are resorted to, with so much benefit; we shall, therefore, take this opportunity of making a few remarks on their employment in general; as well as the best modes of exhibiting them in the present forms of disease. The objects with which alkalies are usually administered, may be stated to be threefold; first, with reference to the prevention of lithic acid deposits; secondly, with reference to their solvent effects on lithic concretions, already formed; and thirdly, with reference to their peculiar alterative effects. On each of these points we shall make a few remarks.

We have stated in another place, that alkalies appear to exert no curative influence of a permanent kind on lithic acid deposits; but that their operation is limited to their immediate effects on the acid and unnatural matters resulting from deranged assimilation. It follows, therefore, that alkalies, to be beneficial in preventing lithic acid deposits, must be so administered, as to counteract acidity at the moment of its development; and that their use must be daily and constantly repeated for a long time. With respect to the first of these points,—the moment best suited to counteract the acidity of digestion,—it may be remarked that in different instances it varies considerably; but that it usually lies between two and six hours after eating. As an average, perhaps, three or four hours after a meal will be found the most appropriate. If the proper period for taking alkaline remedies be attended to, it will be found that a very small proportion of the remedy will, in all instances, be sufficient to accomplish the purpose; that is, from ten to twenty grains of the carbonate of potash will, in almost every case, be found amply sufficient to counteract the acid residuum of the meal; which in fact is all the real good that can probably be expected from the use of the remedy. I have generally preferred potash, on account of the greater solubility of the

potash lithates ; but soda or the phosphate of soda is more grateful to a few stomachs ; while others prefer magnesia. The good effects of magnesia as an antacid in *stomach* affections, have been much overrated ; at least, such is the result of my own experience. In acidity of the cæcum and colon, and the peculiar symptoms dependent on such acidity, magnesia is the preferable antacid ; because the soluble alkalies are absorbed long before they reach the lower bowels ; except they be taken in large and otherwise injurious quantity. I generally prefer the carbonate of potash to the *liquor potassæ* ; in those, however, who are incommoded by the carbonic acid extricated from the carbonate, the *liquor potassæ* is preferable. In almost all instances, likewise, I associate the potash with a few grains of nitre ; from the sedative effects of which on the morbid irritability of the stomach usually present, the utmost benefit is often derived. In general, I make no other combination ; and think that when alkalies are given as mere antacids, they are best exhibited alone. By giving alkalies in combination with tonics, the good effects of both are often lost ; but their separate use is often highly beneficial. Thus I often give tonics, (even the mineral acids,) before and between the meals, at the same time that alkalies are taken after meals ; and with the best effect. When it is necessary to give alkalies with reference to their diuretic as well as their antacid effects ; or when more than usually powerful antacid effects are indicated, the alkalies may be often advantageously combined with a vegetable acid ; such as the citric, tartaric, or malic acids. In this case, the alkalies may be either administered still, or in an effervescent form, as the circumstances of the patient may require ; they may be also beneficially combined with some other diuretic, such as the *spiritus aetheris nitrici*, the *spiritus juniperi comp.*, &c. This mode of exhibiting alkalies, it need scarcely be stated, is particularly indicated in cases of great irritability of the stomach ; or of febrile action accompanied by scanty and high-coloured urine, of more than ordinary acidity.

The second object with which alkalies are exhibited in lithic acid deposites, viz. their diuretic and solvent powers,—comes now to be briefly considered. Attempts have been made to dissolve lithic acid concretions of all kinds, situated in the kidneys and

bladder, by the exhibition of large doses of alkalies both in the carbonated and free state ; and wonderful stories have been related of the success of the remedies thus exhibited. That in some constitutions large doses of alkalies can be taken for a great length of time, with apparent impunity, and so as not only to affect the urine, but even to act on lithic acid calculi lodged in the kidney and bladder, I have no doubt. The practice, however, in general, cannot be said to be a safe one ; and in many instances its application is impossible. The best mode of accomplishing the object when practicable, is to dissolve the alkali in a large quantity of water ; and in this way both the diuretic and solvent powers of the remedy will be exerted at the same time. On this principle many of the natural mineral waters may be supposed to act ; such, for instance, as the waters of Vichy in France, which may be placed at the head of a very numerous class of similar waters, each differing in its degree of alkaline power, and in various minor circumstances, but all operating on the same general principles. Of the waters in England most celebrated for these affections, those of Malvern may be mentioned as the chief. The quantity of alkali which the waters of Malvern contain, is exceedingly minute ; indeed their leading character consists in their extreme purity ; yet from their continual use, great benefit is often derived ; of which I have seen repeated instances. They may be taken in any quantity *ad libitum*, and at the same time employed for all the common purposes of domestic water. As already mentioned, many of the waters obtained by boring in the London district, resemble the Malvern waters for their general purity ; while they often contain a little carbonated alkali. Hence such waters often agree remarkably well with those who are subject to lithic acid deposits. I do not think it necessary to enter further at present on the subject of mineral waters. An account of the numerous mineral waters on the Continent which have been celebrated for calculous affections, will be found in writers on the subject ; to whom I beg leave to refer. The few further remarks we have to make on the solvent powers of alkaline remedies will be given when we come to speak of diseases connected with the presence of lithic calculi in the bladder.

With respect to the third object with which alkaline remedies

are administered, viz. their *alterative* effects, we have little to do in this place. When thus exhibited, their caustic form is usually preferred : that is to say, in various chronic affections, the *liquor potassæ*, either alone or in combination with some alterative or bitter decoction or infusion, as the *decoctum sarsaparillæ*, the *infusum gentianæ*, &c., is to be persisted in for a considerable length of time in free doses. The chronic affections particularly alluded to, are, various scrofulous enlargements of glands or other organs ; the power exerted over which in some instances, by the free alkalies when judiciously administered, is very considerable ; particularly when conjoined with the use of the hydriodate of potash. The use of alkalies, however, with these views, as already stated, scarcely falls within our present design. '

Before we close the subject of alkalies, it may be remarked, that there are some individuals who cannot take alkalies in any form, however strongly their use appears to be indicated. I have seen several instances of this inability ; and in most of these cases have observed that the lithic acid was deposited in the white plastic state we have formerly described. In these cases, the peculiar effects produced by the alkalies were great nervous disturbance ; particularly of the cerebral functions. In one gentleman, between fifty and sixty, in particular, the excitement produced by alkalies was so great as to border on delirium or mania. In this case, immense quantities of nearly white lithic acid, mixed with a little lithate of soda, was voided in irregular masses, which caused the most acute suffering both in passing from the kidney, and afterwards in the bladder. The urine was acid, and everything strongly indicated the use of alkalies, which were most carefully tried in every form, but without success ; they seemed to act like a poison ; and there was reason to believe, from the effects produced, that if their use were persisted in, they would even lead to a fatal termination. I lost sight of this curious case after a short time, and do not know what became of the patient. In some instances, when alkalies cannot be tolerated in a free or carbonated state, they can be taken in conjunction with a vegetable acid. In other instances, the addition of ammonia will cause them to be borne. Again, potash disagrees with certain individuals, who can take soda or magnesia with impunity, &c. The effects of alkalies at all times, in large doses, and ad-

ministered at improper times, is injurious to the system. They not only derange the assimilating functions, but produce serious disorder of the nervous system; in short, they so operate, as to perpetuate, rather than cure, the diseases for which they are administered. In certain habits also, and under certain circumstances, the injudicious use of alkalies occasions a deposit of the phosphates in the urine; and thus produces a more formidable disease than that which they are intended to cure. On the contrary, when judiciously given in small doses, I have never witnessed any injurious effects follow the employment of alkalies; though their use has been daily persisted in for years together. I believe, also, that when thus administered, in gouty and dyspeptic habits, they are capable of doing a great deal of good, by preventing those troublesome secondary effects, which frequently arise from acidity in the *primævia*; among which the deposition of lithic acid is one of the most prominent. Lastly, it remains to state, that alkalies have been said to exert their bad effects by attenuating the blood; and by inducing general weakness and emaciation. What is meant by attenuating the blood, I do not understand, and therefore cannot speak on the subject. That the free and injudicious use of alkalies promotes absorption of the living solids, and thus attenuates the body, there seems to be little doubt. This effect of alkalies, however, is not invariable; and is much more striking in some instances than others.

Although the employment of alkalies in lithic acid deposits is thus so generally useful; yet it must be borne in mind that their operation is not of a *curative*, but of a corrective nature only; hence in the treatment of these affections, the use of alkalies must never be trusted to alone, but their good effects must be secured and maintained, by conjoining with their use certain other means, and particularly purgatives and alteratives. Moreover, in the general administration of these remedies, the age and condition of the patient must be taken into account. We shall, therefore, briefly consider the application of these and other remedies at the four different periods of life formerly mentioned; viz. before puberty; between puberty and the age of forty; between forty and sixty; and in extreme old age.

From the great tendency to deposit lithic acid by the children of gouty and dyspeptic parents; and particularly by the chil-

dren of those who suffer from urinary diseases in general; from the great risk there is also at this early period of life of the formation of calculus in the bladder; it becomes a duty highly incumbent on parents to watch the condition of their children's urine. They should constantly bear in mind that by a regulated diet, &c., the formation of a stone in the bladder may very probably be prevented; while this fearful malady will almost as certainly be the result of inattention. I have repeatedly seen instances in which children, strongly disposed to these affections, have been sent to school and otherwise neglected, and who have suffered in consequence from stone in the bladder. Moreover, such children should never be considered as secure, till after the age of puberty; when, as we have stated, the tendency to this affection is much diminished, or at least becomes less dangerous; and when of course they become old enough to attend to themselves. In the management of children with these affections, attention to diet is, in the first place, of chief importance. Left to themselves, children partake, in preference, of all sorts of sour and sweet things, the whole of which ought to be strictly prohibited. They should be also carefully prevented from eating *too much*, even of bread or of milk. A plain and simple diet, consisting of a due admixture of animal and farinaceous matters in moderate quantity; the use of the purest water; and free exercise in the open air, are requisites so essential in the treatment of these affections in children, that, without attention to them, all other means will be found of little avail. The use of alkaline remedies in early life requires some care. The urine of children, even when considered healthy, is liable to great and sudden changes from a variety of causes, so that one day we find it acid, and the next perhaps neutral or alkaline. Alkaline remedies, therefore, should be given in small doses, and their effects should be watched. Five or six grains of the carbonate of potash or of magnesia, given twice a day, two or three hours after breakfast and after dinner, will in most instances be found quite sufficient for children under ten years of age; and even this quantity will occasionally require to be suspended for a time. By the aid of these means, and the occasional employment of mild purgatives or alteratives, as the *hydrarg. cum creta*, I have, in a great many instances, seen the deposition of lithic acid kept in abeyance

during the whole period of childhood, and after the age of puberty cease altogether.

The period of manhood is, as we have stated, very little subject to lithic acid deposits. In those instances in which such depositions take place at this period of life, the practice will differ but little from that which we have to state as applicable to the middle period of life, when, next to childhood, the tendency to these depositions is perhaps the most strongly marked.

Besides the steady use of alkaline remedies on the principles formerly stated; at the middle period of life, other remedies are usually required to ensure and maintain their good effects. Alkalies, therefore, can now be seldom trusted to alone, but their use must be conjoined with appropriate purgatives and alteratives. In the decided cases of gravel and concretions which occur in middle life, there is, usually a congested state of the whole abdominal viscera, and particularly of the hepatic system, requiring active purgatives and alteratives. These must be selected and adapted to the particular case, according to the judgment of the practitioner; but if the patient has been accustomed to the stimulus of calomel, nothing but calomel will be found to answer the purpose. In other cases, a few grains of the blue pill, or of the Plummer's pill, may be taken at night, and followed the next morning by an active dose of the subsulphate of magnesia; or of a mixture of Rochelle salts and magnesia, with senna, &c. The use of these means must be repeated according to circumstances; and if there be a tendency to gout, colchicum may be often advantageously combined with the remedies stated. These means will usually subdue the acscent state of the urine; and when this is accomplished, remedies, more especially of a diuretic nature, as nitre, the *spiritus aetheris nitrici*, &c., may be associated with them according to circumstances. Ordinary attacks of gravel rarely fail to yield to these means, if properly directed. When the symptoms run still higher, and there is indication of the formation of a calculus in the kidney, other means, to be detailed hereafter, adapted for this particular emergency, must be resorted to.

We have said that about the age of forty, the lithic acid may occasionally be considered as a sort of *materies morbi*; that is, the cause of irritation in the constitution, whatever it may be,

seems to be transferred to the kidneys; which are induced to secrete an extraordinary quantity of lithic acid, and thus to meliorate the system in general. On a similar principle, the good effects long ascribed to certain remedies of the active diuretic kind, may be probably explained; such remedies appearing to possess the power, when given in favourable conditions of the system, of exciting the kidneys to separate large quantities of lithic acid; and in this way, by bringing about an artificial crisis, to produce great and immediate benefit. Thus Dr. Henry has mentioned cases in which *several ounces* of lithic acid were brought away in the course of a day or two, by a remedy apparently composed of turpentine and laudanum chiefly.*

In remedies of this class, opium, not only on account of its sedative properties, but from the property it likewise possesses of increasing the secretion of lithic acid, should probably in most instances form a constituent principle; but the diuretic ingredients may vary. Thus, instead of turpentine, a combination of muriatic acid and opium will sometimes answer very well; particularly when the lithic acid is not disposed to concrete, but to come away in the form of gravel: or the terebinthine remedy may be conjoined with the acid and opium. When, on the contrary, the lithic acid is more disposed to concrete, the muriatic acid may be omitted, and the *liquor potassæ* may be substituted, by which means the lithic acid may be held in solution; and this, perhaps, in most instances is the safer combination. To this class of remedies may be likewise referred many of the ancient and still popular remedies in gravelly affections, such as the seeds of the wild carrot; the parsley breakstone, (*alchemilla arvensis*,) &c.; many of which produce a large secretion of lithic acid in particular states of the system. Even *hard waters*, however paradoxical it may appear, sometimes do good on the same principle, and, by acting as diuretics, bring away large quantities of gravel; of which I have seen many instances. Occasionally, however, a mere change of water, not only from soft to hard, but

* Med. Chirurg. Trans. x. 136. Dr. Henry thinks that in these cases the lithic acid brought away was previously lodged in the kidneys. This might have been the case in part; though I cannot help thinking that by far the greater portion of it was actually secreted under the influence of the medicine.

the reverse, will have the same effect. That such remedies are calculated to do good when judiciously applied, there can be no doubt; but, on the other hand, when indiscriminately exhibited, they are liable to do much harm. Thus, when there is a tendency to active inflammation in the kidney, or when the presence of a renal calculus is suspected, too large to pass the ureter, their exhibition will be likely to increase the affection; nor does their employment seem to be adapted to any species of deposite, except crystallized lithic acid; nor even perhaps in this form of the disease, when occurring in very young, or in very old subjects. Moreover, as remedies of this class do not appear to exert any beneficial action, in any case, in removing the peculiar tendency to gravel, and are calculated to answer a particular and temporary purpose only; the moment this purpose has been effected, they should be no longer employed; but the means adapted to prevent a tendency to the affection, should be recurred to. As a remedy in lithic acid deposits, Mr. Ure has recommended the benzoic acid and its compounds; which he supposes to act on the principle of converting the lithic into the hippuric acid.

It cannot be too strongly impressed upon those who suffer from gravelly affections in middle life, that the *cause* of these affections lies deep in the constitution; and that to counteract their distressing effects, perseverance in the appropriate diet, regimen, and medicine, is absolutely necessary. It is absurd to look for permanent relief in these complaints, by attention to regimen and medicines for a few days or weeks. In obstinate cases, an adherence, more or less strict, according to circumstances, to the principles above stated, should be adopted for months, or even for years, to ensure success. This will be scarcely thought irksome by those who affix a just value on health. By a few sensualists it may be considered a species of slavery and sacrifice of enjoyment, too great to be endured for any *future* good whatever.

Perhaps the most dangerous form, in every point of view, which the lithic acid assumes, as well as the most difficult of treatment, is that above described as occasionally occurring in old people. For, on the one hand, if a sudden stop be put to the secretion, whether by the appropriate remedies or otherwise, great constitutional derangement is likely to follow, with sudden and fatal

determination to the head or other parts; as I have more than once known to happen. On the other hand, if permitted to proceed unchecked, from the combined effects of so many concurring circumstances at this time of life, the formation of a calculus in the bladder will almost certainly take place. In such cases it is impossible to lay down any specific plan of cure, which must depend on circumstances; but in general the principles of treatment must be of the constitutional and preventive kind formerly laid down; and in conjunction with these, the application of leeches to the region of the kidney, or an issue or seton in the back, may be had recourse to; particularly if organic disease be suspected.

It may be observed, generally and in conclusion, that from the little pain usually occasioned by the descent of pisiform concretions from the kidney, and the ease with which such concretions either escape, or are subsequently removed from the bladder, when this organ is in a healthy state; it will, in most instances, be the safer plan to interfere as little as possible with the formation of these calculi by active treatment; and to trust chiefly to a careful diet, and the regularity of the common functions only. On the other hand, if the prostate be much enlarged, and the bladder irritable, as it is too apt to be at this time of life, more active treatment of the preventive kind will be often proper; for it may be remarked, that under such circumstances active treatment of the preventive kind may be often employed with much less risk to the constitution, than when the bladder is sound—the disease and irritation of the bladder seeming to act, as it were, as a sort of safety-valve, and thus to divert the mischief from falling on more important organs. Hence patients labouring under chronic affections of the bladder seldom die of sudden attacks of the brain, &c., except perhaps in the last stages. Lastly, it may be proper to remind the reader, that from the proneness to an alkalescent state of the urine in advanced life, particularly when the prostate and bladder are affected, alkalies are not so well borne as in the earlier stages of the affection; hence their effects must be carefully watched.

Such are the leading principles of treatment to be attended to in the management of lithic acid diseases at different periods of life. Those who have carefully studied these affections will, I

think, at once acknowledge the general truth of these principles, and readily understand how they are to be varied so as to meet particular exigencies; while those who have not studied these diseases as they deserve, will be furnished with a clue to their general nature and treatment.

Transition from the Lithic to the Phosphatic Diathesis.—In changing from the lithic acid to the phosphatic diathesis, the urine often passes through the intermediate grade of the oxalato of lime diathesis; we shall therefore speak of these two grades of change in connexion.

The first circumstances in the condition of the urine, which generally denote a change from the lithic acid to the phosphatic diathesis, are the general paleness of its colour, and sometimes its increased quantity. There is also a great tendency from the slightest causes to amorphous sediments, which are generally of a pale colour.

In some instances, the sediments in the earlier transition stages are of a dirty brownish yellow, in others of a peculiar salmon-like tint; and in this last case they often assume a characteristic appearance very difficult to describe, but which may be compared to pus or other globular matter tinted red. In such cases the sediments almost always contain more or less of oxalate of lime, as well as an unusual proportion of the phosphates and of urca, and sometimes fatty matter. Such urine is commonly of high specific gravity, (i. e. of at least 1·030 or above,) and strongly acid; hence the phosphates though present in excess, are, in the earlier stages at least, held in solution.*

* The phenomena here described have been long familiar to me, and are alluded to in several places in the previous editions of this volume. They may be regarded as instances of the different phases assumed by urinary diseases, and which are so numerous, that it would be impossible to describe them all under any circumstances; but particularly in a treatise of the present general character. Observation and experience alone will render the student familiar with these and numerous similar phenomena, which, if he has thoroughly studied the principles, he will find no difficulty in understanding. I have noticed these forms of disease here, as they have been recently more particu-

In other instances, especially in certain conditions of the general health connected with diseases of the skin, and mucous surfaces of the kidneys, &c., the urinary sediments often contain a considerable proportion of the lithate of lime, sometimes alone, but usually mixed with various proportions of the oxalate, carbonate, and phosphate of lime. These admixtures exist in different instances, and even at different times in the same instance, in every possible degree. The urine in these cases is variable in quantity and in specific gravity; though the specific gravity rarely surpasses 1.030. Such urine is seldom quite transparent when passed, on account of the presence of an increased proportion of diseased mucus; and the portion of urine passed, during the night more especially, will, on the application of heat, almost always be found to become turbid from a deposition of the phosphates.

As the tendency to change from the lithic acid to the phosphatic diathesis increases, the urine, though acесent when passed, may be frequently observed, after standing some hours, to be covered on its surface by an iridescent pellicle, which, on examination, will be found to consist of the triple phosphate of magnesia and ammonia. And if at this time it be suffered to remain at rest for a while, especially in warm weather, it becomes putrescent; and will be frequently found to contain large spicular crystals of the variety of the triple phosphate of magnesia and ammonia, termed by Berzelius the *bibasic*. As the changes proceed, the urine gradually assumes a more decidedly whey-like colour, and is either alkaline when passed, or speedily becomes so. The lithate of ammonia also diminishes in quantity, or entirely disappears, while the quantity of triple phosphate is increased. In short, this last stage runs into the confirmed phosphatic diathesis by such imperceptible grades, that in a practical point of view it is difficult or unnecessary to draw a line of distinction.

The transition from the other varieties of urinary disease above described to the phosphates is easy, and in some instances very brief. The chief phenomena of such transitions have been already noticed in speaking of the transition from the oxalate of lime to the phosphatic diathesis; and if the general character of these largely described by Dr. Golding Bird. With his description and observations in general I quite agree.—See Medical Gazette for 1842. Also the Third Part of this volume.

phenomena be well understood, there will be little difficulty about the numerous varieties presented by them in different instances ; as we have already stated.

The constitutional symptoms in all these transition states are of an irritable character, though they differ considerably in subordinate particulars. In the simple transition from the lithic acid to the phosphates, there is usually considerable disorder of the assimilating functions, with more or less pain in the back, and bladder ; particularly in gouty habits. If there be no stone present, however, and the affection be properly treated, the symptoms can be generally arrested. For this purpose, the salts of ammonia, as the citrate of ammonia, conjoined with some appropriate sedative and alterative, will be found to answer best ; and the use of the fixed alkalies must be sparingly resorted to, or withdrawn altogether. When the more urgent symptoms have subsided, and the urine has begun to resume its natural appearance, some light tonic or bitter, as the infusion of hop, &c., will be found useful.

In those cases in which the sediments contain the oxalate of lime, the dyspeptic symptoms are generally more severe and obstinate ; in short, they partake more or less of the character of the symptoms marking the oxalate of lime diathesis ; to which we refer the reader. In such cases the fixed alkalies must be used with caution, and more benefit is usually obtained from the judicious employment of the mineral acids and tonics, with the occasional use of a little *liquor potassæ* or of magnesia, three or four hours after eating.

In the class of transition cases, in which the phosphate and carbonate of lime predominate, and in which, as we have stated, the mucous membranes of the kidneys are commonly more or less diseased, there is great risk of the formation of stone ; and even when a stone is not present, the patient usually suffers much from renal irritation ; and sometimes even from irritation of the bladder. In such cases, various alteratives, as the *liquor potassæ*, or hydriodate of potash, with sarsaparilla, *infus. diosmæ*, &c., are useful. I have also seen benefit from a course of the nitro-muriatic acid. In spite, however, of all we can do, the disease on the whole will often proceed, and sometimes terminate in destruction of the kidney more particularly affected.

SECTION d.—*Of Cystic Oxide.*

SINCE the second edition of this volume was published, several opportunities have occurred, both to others and to myself, of investigating this rare species of disease. A most important discovery also has been made in the composition of the cystic oxide, which not only throws considerable light on its properties, but also on the pathology of the diseases with which it is connected. The disease, however, must still be considered as very rare, at least in its decided form ; we retain, therefore, the following brief history of the discovery of this form of calculus, given in the previous editions, in order that we may complete it up to the present period ; and thus throw all the light we are able on a form of disease which we must acknowledge, from its rarity, to be imperfectly understood, even at the present time.

The first specimen of cystic oxide calculus, described by Dr. Wollaston, its discoverer, was taken from a boy five years old, and was covered with a loose coating of the phosphate of lime. This boy afterwards died from the formation of another stone, which consisted principally of the lithic acid ; but was peculiar in having its centre hollow, by the removal, apparently, of some more soluble substance of which the nucleus had consisted. *

The second specimen was likewise described by Dr. Wollaston, and is preserved in the collection of Guy's Hospital. It was taken from a man thirty-six years of age, of whose case no particulars are recorded.

Soon after Dr. Wollaston's paper was published, Dr. Henry recognised two specimens of this variety of calculus in his collection ; but with the histories of both he was unacquainted. †

* Philos. Trans., 1810, p. 223.

† Marct, p. 82, first edition. Henry, Med. Chirurg. Trans., vol. x. p. 140.

The next case on record is described by Dr. Marcket.* It was removed from the bladder of a gentleman about twenty years of age. This gentleman, both before and after the operation, passed several small calculi, composed of the same substance, all of which had been distinctly traced from the kidney down the ureter by the usual symptoms. After the operation he had no symptoms of stone in the bladder, those descending into that organ having been discharged immediately. His general health was good, except when the calculus was passing down the ureter; though he was rather subject to be bilious or dyspeptic; but he was never troubled with acidity. Subsequently, the fit of pain, previous to the evacuation of calculi, which used to occur about once in three months, became much milder, and the haemorrhage ceased; though the evacuation of calculous matter in small quantities recurred even more frequently than before; that is to say, about once a month. With the future history of this gentleman I am unacquainted.

For the next two instances we are likewise indebted to Dr. Marcket. The first of these occurred in a gentleman thirty years of age, who had died with symptoms of renal calculi. On examination after death, a number of calculi were found in the kidneys, which proved to be of this variety. The second case was that of an elder brother of the same gentleman, who had died of a similar affection, and in whose kidneys calculi of a similar kind were found, accompanied by extensive disorganization of the kidneys and prostate gland. It may be worth while, also, to remark, that a third brother of the same family died with symptoms of calculi; but their nature was not ascertained.

Two cases of this form of disease have occurred to Mr. Brande, who has heard of no others. In one, the calculus was voided by a labourer, but no particulars were known of his case. In the other, several of these calculi, varying in size from a pin's head to that of a pea, had been voided, at different times during a period of thirty years, by a gentleman forty years of age. He had been subject, from the age of six or seven years, to pain in the region of the loins, not confined to any particular spot, and seldom of any acuteness, or such as to prevent his ordinary occupation,

* Op. et loc. cit.

which obliged him to lead rather a sedentary life. His usual state of health was good ; his habits were regular ; his diet ordinary and plain. He had used soda water, magnesia, and the alkalies, without any advantage. The further history of this case is unknown.*

A short time before the second edition of this work was published, I had an opportunity of seeing a case of this rare form of disease for the first time, through the kindness of Sir Astley Cooper, who sent the gentleman to me to have the nature of the stone he had lately passed from the kidney, ascertained. This gentleman appeared to be about thirty years of ago. He had been subject to urinary diseases since 1818 ; when, in consequence of exposure to cold, he was seized with severe pain, accompanied by inflammation of the kidneys. Six months afterwards, he, for the first time, observed retention of urine, from what appeared to be calculus in the bladder ; and, in 1820, a stone was extracted from the bladder which weighed upwards of two ounces. The nature of this stone does not appear to have been ascertained ; but it was *supposed* to be oxalate of lime. The present small calculus, which consisted of pure cystic oxide, passed down from the left kidney, about a fortnight before I saw him, with considerable pain. Since that time he had been taking alkaline remedies ; which appeared to give him more relief from the severe harassing pain in the back, that he was almost always subject to, than anything else. The urine voided in my presence about five P. M. was copious ; of a yellowish green colour, and strong peculiar smell. Its specific gravity was 1.020 ; and, almost immediately on being passed, a greasy-looking film was formed on the surface ; and at the same time rather a copious pale-coloured precipitate appeared ; and the urine became alkaline. The film and sediment consisted chiefly of the triple phosphate of magnesia and ammonia, mixed with a little cystic oxide. There was very little urea ; and hardly a trace of lithic acid was perceptible on the addition of an acid.

The urine passed early the next morning (all medicine having in the mean time been omitted) was more remarkable, and characteristic, I presume, of this affection. Its colour and appear-

* Royal Institution Journal, vol. viii. p. 71.

ance were much the same as before, except that the tint was a little deeper, and the peculiar smell stronger. It very faintly reddened litmus paper; and its specific gravity was 1·022. There was a slight deposition on standing for some time, consisting of a mixture of the cystic oxide, with a little of the triple phosphate. A considerable proportion, however, of the cystic oxide was precipitated from the urine on the addition of acetic acid, which of course held at the same time the phosphates in solution.

This gentleman seemed strong and robust; but was liable to affections of the stomach, which appeared to rise, in part at least, from sympathy with the derangement of the kidney. What is remarkable, he stated that he had a twin-brother who was likewise subject to urinary affections; but of what kind he could give no information.

About the same time, Professor Stromeyer found the cystic oxide in the form of gravel; and also in considerable quantity in the urine of a patient afflicted with stone. "In this urine the lithic acid was almost entirely wanting; nor was the urea found in it in the natural quantity."* M. Lassaigne also met with this substance in the form of calculus in the bladder of a dog.†

In 1828 a case occurred to Dr. Venables, who has described it in the Royal Institution Journal.‡ The patient was a stout corpulent woman, forty-seven years of age, who passed a small calculus of this substance, weighing eighteen grains. The urine presented properties and phenomena very similar to those above described; and, like that specimen, appeared to be remarkably deficient in urea and lithic acid. Dr. Willis, in his work on urinary diseases, states that he has recently detected cystic oxide in a case in which no renal calculus had been passed, or was supposed to exist. The urine had the greenish yellow colour, the peculiar smell, and the oily-like appearance above described, and these properties drew his attention to the circumstance. It

* Annals of Philosophy, (new series,) vol. viii. p. 146.

† Ann. de Chimie et de Physique, vol. xxiii. p. 328. Also Annals of Philosophy, (new series,) vol. vi. p. 316.

‡ Journal of Science and Arts, vol. xxix., January 1830.

had a specific gravity of 1·030, and was slightly acid; but no lithic acid could be detected in it; though Dr. W. could not discover that it was deficient in urea. No particulars of the patient are given.*

The next case I shall refer to, is one more particularly described and investigated than any, I believe, which preceded it. The early particulars of this case are given by Dr. Golding Bird. The patient was a young gentleman, at that time about twelve years of age, from whose urethra (where it had lodged) a small cystic oxide calculus was removed by Mr. C. Aston Key, and which is now in the museum of Guy's Hospital.† This stone was removed in May 1836; soon after which time Dr. Bird had opportunities of examining the urine. The specimen voided four days after the operation was neutral, had a specific gravity of 1.01148, contained much mucus, and deposited the triple phosphates intermixed with the cystic oxide.‡ Dr. B. examined different specimens of this urine, voided at various intervals after the operation; and in this the albuminous matter and cystic oxide had disappeared.

In October of the same year this young gentleman came under my care ; and I have occasionally seen him since then till the last year, (1846.) When I first examined the urine it was rather turbid, of a greenish yellow colour, and slightly acescent. Its specific gravity was as high as 1·026. It had a strong disagreeable odour, somewhat resembling putrid cabbage ; and deposited, particularly after meals, largo quantities of the cystic oxide. The nitromuriatic acid was ordered, which seemed to check the formation of cystic oxide ; so that the quantity in the urine at length was almost

* Willis on Urinary Diseases, p. 109.

[†] Guy's Hospital Reports, No. iii. p. 486.

[†] One thousand parts of this urine were found to consist of—

Water	974.444
Urea, with alkaline chlorides, phosphates, and lactates	5.7
Aqueous extract, with alkaline sulphates	14.7
Albuminous matter and earthy phosphates	4.8
Uric acid and adherent mucus	.016
Cyste oxide	.340

imperceptible. He became better, and was sent to school; but in the following summer symptoms of calculus in the bladder became evident; and in October of 1837, a calculus was removed by lithotomy, by Mr. Key, about the size of an almond, consisting of the cystic oxide nearly pure. He recovered from the operation better than could have been expected, and became quite well; except that for two years after the operation, the urine occasionally flowed from him involuntarily. He employed the nitromuriatic acid at intervals after the operation for several years; and the urine became much more healthy than it had been at any time; and the cystic oxide for a while disappeared, and the urine lost the peculiar odour of the disease.* It is remarkable that two younger brothers of this gentleman suffered from lithic acid deposits; though I could not find any cystic oxide in their urine at that time. Since that time (March, 1844) I have found the cystic oxide in the urine of a brother and sister of this gentleman. The sister, a girl of thirteen, had complained of almost constant pain in the region of the right kidney for many months. I am unable at present to state further particulars of these cases.

September, 1842. At this date I saw two cases, on two succeeding days, in which the cystic oxide abounded in the urine. One in a boy of seventeen, with all the symptoms of a stone in the bladder, though none was found on sounding; and another in a middle-aged man, who had indulged freely in the use of spirits, wine, &c., as well as in eating. Both subjects were of a delicate and unhealthy look; but the elder had a bloated and tallowy appearance; and several years before had applied to me for some urinary affection. The father of the boy also had been twice my patient for a formidable haemorrhage from the bladder.†

* I had an opportunity of examining the urine in this case about a year ago. It then contained cystic oxide, but no unpleasant symptom was complained of. He had grown tall and stout; but had an unhealthy look.

† This young gentleman is still living, and apparently well. I have had no recent opportunity of examining the urine. His father has lately died from haematuria. In the bladder, near one of the ureters, was found a malignant tumour from which the bleeding had taken place. Both kidneys also were diseased, and contained cysts, the largest of which in the right kidney occupied a full third of its upper part, and had bony matter deposited in its walls.

Dr. Bird has expressed an opinion that the cystic oxide occurs in the urine in small quantity more frequently than has been suspected. My own observations lead me to the same conclusion; and I have reason to believe that the peculiar smell emitted by the urine in certain forms of organic disease, depends on the presence of cystic oxide, or some analogous substance. A late writer has expressed an opinion that the cystic oxide disease is of an hereditary character, and runs in members of the same family; and of this he adduces several remarkable instances. The facts I had formerly mentioned led me to the same conclusion; and I have now very strong grounds for believing that this diathesis is connected with certain hereditary forms of disease.*

Dr. Marct has observed that all the specimens of cystic oxide calculi which he had noticed were remarkable for their purity; and hence he concludes that this diathesis has a more exclusive tendency in regard to the formation of other kinds of calculi than any other species of urinary concretion. Like the oxalic and lithic acid diatheses, however, the cystic oxide diathesis may be evidently followed by the phosphates; as appears from one of the specimens of calculus above described; and also from the examination of the urine; in which the tendency to the deposition of the phosphates had been evidently produced by the use of alkaline remedies. This diathesis, like the mulberry, may be also followed by the lithic acid diathesis; as happened in one of the instances given by Dr. Wollaston above quoted. Dr. Henry also mentions an instance of a lithic acid calculus having a nucleus of cystic oxide. Dr. Bird has, moreover, given an instance in which the cystic oxide must have *cocxisted* with the oxalate of lime, and the lithate of ammonia diathesis, as well as with the phosphates; but the inference he draws from this solitary fact appears to me unsatisfactory; and I have not the least doubt, from my own observation, that Dr. Marct's *general* conclusions respecting the exclusiveness of the cystic oxide diathesis, when fairly established, is quite correct.

With respect to the *causes* of the cystic oxide disease, it may be observed, that in most of the cases mentioned, an inherited predisposition to the affection, as to most other well-defined

* See below.

urinary diseases, has seemed to exist. Of this fact, the circumstance, noticed by several writers, that more than one member of the same family suffered from the disease, offers a striking illustration. As a further illustration of the same observation, I may remark, that the maternal grandmother of the young gentleman whose case I have briefly given,* died of extensive and peculiar disease, both of the kidneys and liver. The exact nature of the disease was not ascertained; but the symptoms and phenomena of the affection appeared to indicate an affection of a malignant character. Among other remarkable circumstances, fatty matter was often voided in the urine; and the waxy character of the countenance, and other symptoms, appeared to denote the presence of that peculiar form of hepatic disease, termed *greasy* liver. With a strong predisposition to the disease, a variety of causes may excite it into activity. Thus, in one of our instances, exposure to cold appears to have operated as the exciting cause. Of the *proximate* cause or intimate nature of the affection we can say little. The peculiar composition of the cystic oxide, and particularly the presence of sulphur, appear to denote its albuminous origin; and to show that its formation results either from an imperfect assimilation of the albuminous principle; or, most probably, from the future action of the kidney on such imperfectly developed albuminous principle.

The *diagnosis* in this affection is sufficiently marked by the peculiar properties of the cystic oxide itself; and by the properties of the urine. With respect to the *prognosis*, from all I have since seen, I am more and more confirmed in the belief I formerly expressed, that it is generally unfavourable. I then stated that in most cases the affection seemed to be connected with diseased kidney, of which it appeared to be the consequence or cause; and that in all instances an inveterate disposition to urinary diseases, apparently inherited, was evident; observations fully borne out by my subsequent experience.

Lastly, with respect to the *treatment* of the affection, little, perhaps, can be satisfactorily stated. A carefully regulated diet, consisting chiefly of animal and farinaceous matters, seems to be indicated; while all indigestible matters, all severe exercise, and other circumstances calculated to derange the stomach, or excite

inflammatory action and fever, to which there seems to be a strong tendency, should be avoided. Among remedies, alkalies may be sometimes proper; but much more frequently the use of acids, or of the chlorate of potash, seems to be indicated. Of acids, I have generally preferred the nitro-muriatic; which I was first induced to employ, from observing its remarkable power of correcting a strong and peculiar odour occasionally connected with the urine; and which seems to be closely allied to the smell produced by the cystic oxide. Under the use of this acid, I have seen the peculiar smell of the urine in the cystic oxide diathesis very much abated; and all the properties of the secretion so much improved, that the peculiar principle itself has for a time disappeared. On leaving off the remedy, the complaint, however, in general, has shown a disposition to return; but, by recurring to the medicine, the deposition has been again suspended; and this alternation has repeatedly occurred in the same individual.

It need scarcely be noticed, that attention to the general health, and especially to the state of the bowels, will be proper. Mercurial alteratives and purgatives, also, may be occasionally required; but I have reason to believe, that mercury, if pushed too far, is capable of doing much mischief. Finally, if obvious disease of the kidney be present, local counter-stimuli, as setons or issues, may be serviceable in some instances.

Xanthic Oxide and Hippuric Acid.

The pathology of these two substances, which are undoubtedly of albuminous origin, remains to be briefly noticed.

Xanthic oxide. This substance, constituting a rare species of calculus, must occasionally exist in the urine; though its presence, as far as I know, has not yet been detected in that secretion. The little we know of it is principally derived from the calculi alluded to, and which for the most part have been obtained from children. In one instance, xanthic oxide has been found also as a deposit

in Diabetes.* From its chemical relation to lithic acid, the pathology, &c. of xanthic oxide is probably very similar to the pathology of lithic acid; though for the reasons stated, we know nothing for certain on these points. The natural and chemical history of xanthic oxide, as far as known, will be given in the third Book.

Hippuric acid. Liebig has lately shown that hippuric acid may be obtained from healthy urine. In this opinion Dr. G. Bird coincides; though he thinks the quantity in which it exists in the healthy secretion has been overstated.† It had been long known to exist in the urine of the horse and cow, and I believe other herbivorous animals. It had been said also to exist in the urine of children. By all the earlier inquirers it was confounded with benzoic acid,‡ and it is a curious circumstance that when benzoic acid is taken into the system, it escapes with the urine as hippuric acid. For this fact we are indebted to Mr. Ure.§

I am not aware that hippuric acid either in excess or in deficiency is characteristic of any peculiar disease. It is said to be occasionally found in abundance in the urine of chlorotic, hysterical, and badly fed individuals, in whom the urine is copious, pale, of low specific gravity, and neutral. Such symptoms indicate the general principles of treatment, independently of the presence of hippuric acid; the existence of which, therefore, in the urine, in the present state of our knowledge at least, leads to no peculiar practical result. The natural and chemical history of hippuric acid will be given in the third Book.

* Archiv. der Pharmacie, b. xi. § 173.

† Urinary Deposits, their Diagnosis, Pathology, and Therapeutical Indications. By Golding Bird, M.D. Second Edition. Page 71.

‡ More than twenty years ago I examined this acid as obtained from the urine of the horse and cow. I found it quite different from benzoic acid, but did not follow up the inquiry.

§ Med. Chirurg. Trans., Vol. xxiv.

Of Struma.

As an intermediate link between albuminous and oleaginous mal-assimilation, and involving both, we shall make a few remarks on *struma*. The subject in all its details is foreign to the object of this treatise, and our attention will be principally confined to the leading phenomena presented by scrofulous mal-assimilation.

Struma in its established form, may be said to consist in a depraved condition of the whole animal economy. In the manufactory of the constituents of the frame, the enfeebled vital energies fall short, as it were, of their purpose, and produce results exceedingly prone to throw off vital allegiance altogether. Hence in the abnormal deposites and growths we term *scrofulous*, material properties are ever ready to triumph over the vital, and emancipate the incarcerated elements from the trammels of organization.

A predisposition to struma is often inherited; but it may be also acquired under circumstances unfavourable to the health. The following statements will leave little doubt on these points. In the mean time, taking for granted that the reader is acquainted with our views of assimilation in the third Book, we shall observe, that though all the assimilating processes, like their products, are more or less affected in strumous habits, the primary processes are chiefly in fault; and particularly those we have termed the *completing* processes—those processes taking place between the duodenum and circulating system, and by which the chyle is principally converted into blood. The nature of the completing processes is very imperfectly understood, and we know little more than the bare facts,—that the white and crude chyle as it appears in the lacteals, on reaching the termination of the thoracic duct, has become in the healthy subject so far resembling the blood in its properties, as to be capable of admixture with that important fluid, and of forming by such admixture, a part of the blood itself.

Now from the constant admixture of a deteriorated pabulum, there can be no difficulty in conceiving that in time the whole mass of blood must itself become deteriorated ; and that everything formed by subsequent processes from such deteriorated blood must be likewise more or less imperfect. We have thus a plausible explanation of the phenomena before alluded to, presented by strumous habits ; together with indications of the circumstances favouring or otherwise influencing their development. These circumstances will now briefly occupy our attention.

The phenomena of struma, as well as the circumstances influencing them, vary considerably at different periods of life ; and it will best suit our purpose to review them under the three different periods of *childhood* or before puberty ; of *manhood* or between puberty and forty ; and of the *stationary* and *declining periods* of life after forty.

When a strumous tendency is not inherited, its formation is perhaps more frequently laid in *childhood* than at any other period of life. As an illustration of this remark, we may observe, that in strumous diseases, whether inherited or acquired, the assimilating organs,—the *mucous membranes* in short, by which aliments are changed and fitted for becoming component parts of the living body, and by which all new products are eliminated, are more especially involved. In very early life these organs, no doubt from their great importance, are preternaturally irritable, and sensitive to slight exciting causes. Hence they are liable to be constantly deranged, and their functions embarrassed, by the improper aliments too often administered to young children. The result is, the formation of unnatural and imperfect products altogether unfitted for the future assimilating processes. These remarks apply not only to the assimilating organs in general, viz., the mucous membranes of the stomach and *primæ viæ* ; but with ten-fold force to the *involved* mucous membranes existing in the form of glands, &c. : for in the case of the mucous membranes of the *primæ viæ*, the unnatural matters formed readily escape, and thus produce only temporary derangement ; but in the case of glands, as elsewhere observed, the circumstances are different ; from the peculiar structure of glands, the unnatural materials brought into contact with, or formed by them, cannot escape, but must accumulate and cause their enlargement. In such cases, particularly

under unfavourable circumstances, inflammation takes place, which too often terminates in partial, if not in total destruction of the organ. Hence the general tendency to diseases of the whole glandular system in young children, particularly when badly fed and exposed to cold, &c. Hence also, the diseases of the mucous membranes of the *prima vîe* and of the mesenteric system, so fatal in infancy.

But there is another circumstance having a very powerful influence in the development and operation of struma as it exists in early, and in mature age. In early life the vital energies have not only to provide for the daily wear and tear of stationary existence ; but to form *de novo* materials adapted for a *progressive vital accumulation*. Under such circumstances, it is not difficult to conceive that the effects of mal-assimilation must be at least doubled—that the stationary fabrics of the body must be deteriorated ; while the *new* fabrics must fall short indeed of the standard of health. In other words,—that the imperfect materials which in stationary existence would have been probably eliminated from the system without producing material damage ; must in early life, for want of better, be actually applied to the building up of the bodily frame.

The radical differences between stationary and cumulative existence, furnish a clue also to many other of the phenomena of the strumous diathesis, as it occurs at different periods of life ; for instance,—viewing the new-born infant in the light of an *incipient rational* being, we find that, brought into the world with a few instincts only, it has not only everything to learn, but to learn by the aid of machinery of its own elaboration. *To know* is the object of its existence ; the machinery for acquiring knowledge, therefore, must be maintained and extended at any rate. Hence the rapid development of the *nervous system* in infancy, to which the whole energies of life are as it were directed. Hence the diseases to which, in addition to those already mentioned, the brain is more especially liable—hydrocephalus for instance, and all the numerous evils of an imperfect organization, ever prone at the best to take on diseased action ; and doubly prone to run a destructive course, from the incessant stimulus of the unnatural pabulum furnished by the erring assimilating organs.

Again, let us consider the position of an individual in *early*

adolescence. At this period the formative and cumulative operations of the system have arrived at their maximum; and the cumulative, after remaining stationary for a while, usually begins to decline, and finally disappears. During early adolescence, the nervous system, as in infancy, is still in a constant state of development; but there is also another system, the development of which predominates in early adolescence over even that of the nervous system. At this period, by a wise arrangement, there is a greater tendency to bodily exertion and activity than at any other—the *muscular system* and its appanages—in short, the *animal* is now to be developed and perfected. The call is for *arterial blood*; and the lungs, the great laboratory where arterial blood is produced, are summoned to do double duty. But alas! the curse of struma again too often counteracts the operations of nature, and destroys her fairest works. The imperfectly developed lungs, unable to supply the demand, sink under the effort; and their destruction, as before with the brain, is accelerated by the incessant excitement produced by the unnatural materials furnished by previous mal-assimilation.

In the *perfectly developed animal*, when the cumulative processes have ceased, and those processes only remain which are required to uphold the standard of equilibrium into which by this time the economy has settled, struma still too often intrudes its baleful influence. By this time, indeed, strumous brains and strumous lungs have usually been swept from the scene; but still there is an ample field left for the operations of this scourge of humanity. Almost every individual, either by inherited predisposition or otherwise, has some weak point; the bust of a Hercules may be associated with the vulnerable heel of an Achilles. Now on this weak point, wherever it may be, struma usually fastens.

As at all other periods of existence, errors in exercise and diet more than any other causes, influence the development of struma in middle age. At this time the business of life has begun in earnest, and habits for good or for evil have become established. The rich man, without an object beyond personal enjoyment, lives indolently and luxuriously, grows fat and gouty, and dies of apoplexy or of some haemotrophic disease. The poor man may live indolently; that is, his daily occupation may be sedentary and unfavourable to health. He may rarely breathe the fresh air, or feel

the cheering influence of the solar rays. From necessity, his food may be deficient or unwholesome ; or from want of knowing better, or from a perverse choice, he may select articles of food ill-suited to his condition ; or become addicted to ardent spirits, tobacco, and other pernicious articles calculated to sap the very foundations of organic life. Such a man rarely becomes fat or gouty, but is prone to hepatic, renal, and other diseases interfering with the development of healthy blood ; and usually dies prematurely from some anaemotrophic disease.

But all rich men, nor all poor men, do not die in the modes stated. Struma promotes many other conditions of the system subversive of comfort and health, which though lingering in their operation, finally prove fatal either to the individuals themselves or to their progeny. For instance, the foundation of disease in the primary assimilating organs, the stomach and *primæ viæ*, and particularly the mesenteric system, may be laid in early life, so that these organs may perform their functions very imperfectly. Nevertheless, after a time, the system becomes reconciled to the unnatural state of things ; the organs become as it were passive ; and under such circumstances, affluent individuals who can command the necessary supply of food, often live to old age. Such individuals usually consume food enough to support three or four healthy individuals, and constitute the enormous gluttons we have before alluded to. *Fruges consumere nati*, they eat and drink of everything with impunity ; the greater portion of the enormous quantity of food they take, passes through them unappropriated, and almost in the condition in which it was taken ; while the portions most easily digested are partially assimilated and taken into the system, and in some way carry on the functions of life. In such individuals, however, the albuminous matters, as we have said, are most imperfectly developed ; and they are often subject to tumours of various kinds ; and sometimes become enormously fat. Under these conditions, as just observed, life among the affluent is occasionally protracted till a late period ; and the individual usually dies at last from hypertrophy of some vital organ ; or from dropsy. On the other hand, the poor man who cannot command the necessary supply of food under such conditions, usually dies in early, or at most in middle age.*

* Individuals thus affected are generally very sensitive to cold, and should repair to a warm climate in winter.

There is a state of things often connected with struma in middle age, directly the reverse of the preceding. To this we have also alluded elsewhere; but it falls to be more particularly considered here. The condition to which we allude is an *unnatural irritability* of the mucous membranes of the *primæ viæ*, and particularly of the stomach, not only prohibiting the indiscriminate use of all sorts of food, but requiring the utmost care and circumspection, both with regard to its quantity and quality. In such individuals, the strumous affection has usually damaged the brain and nervous system in early life; or perhaps fastened at a later period on some of the great secondary organs of assimilation. Individuals thus circumstanced, seldom grow fat; but they are occasionally gouty; or become confirmed hypochondriacs.

When such individuals inherit a gouty tendency, the disease seldom shows itself openly, but attacks insidiously various organs; *e. g.* the kidneys, producing gravel, &c.; the heart, suspending or producing derangements of its action; the head, producing a variety of alarming symptoms, and it may be apoplexy, &c. In this state of things, (in others also,) large quantities of lithic acid or lithate of soda, &c., are deposited in the urine; or if the kidneys be unsound, in the joints of the extremities, in the form of gouty chalk-stones, &c.* With every care, life with such individuals is often embittered; and they either die prematurely, or if existence be protracted, pass their lives in constant suffering. On the other hand, a few individuals whose organs are not hopelessly damaged, and who, wisely taking the hints furnished by their assimilating organs, live abstemiously and carefully, so as to keep these organs in "constant good humour," occasionally pass through life with tolerable comfort; and even escape many of those diseases to which the healthy, but imprudent, are liable.

Such may be considered as the two elementary extremes of derangement of the assimilating organs in strumous dyspepsia; and such their consequences. Between these two elementary extremes, every possible degree and variety of combination exist in different instances; many of which, by keeping these principles in view, may be unravelled by an attentive inquirer; and, by

* I have rarely seen large deposite^s of the lithate of soda in the form of gouty chalk-stones without granular disease of the kidneys.

judicious management founded on the information thus acquired, be much mitigated.

In the preceding remarks we have supposed simple struma, *i.e.*, disorder of the albuminous principles alone, to exist; but in a great variety of instances, disorders of the saccharine or gelatinous, as well as of the oleaginous system, are superadded. In such unfortunate complications, the tendency to evil is fearfully magnified. Indeed the greater portion of all the most painful maladies to which humanity is liable, belong to these complications. Among such complications may, for instance, be reckoned unhealthy tumours, cancer, &c., in all their varieties; the most inveterate skin diseases; the frightful class of malignant affections which, without possessing any tendency to form diseased masses, gradually corrode and eat away the living body; also, fatty tumours of various kinds, and even obesity itself—diseases, many of which, as already pointed out in this volume, are indicated by the condition of the urine and its depositories, the oxalate of lime, the cystic oxide, &c.; and even sugar, in certain diabetic complications.

After this brief sketch of struma and its complications, it remains to inquire,—can these fearful maladies be prevented; or, being inherited or acquired,—can they be mitigated or arrested.

In reply to the first question—can struma and its complications be prevented?—we have no hesitation in saying, that by the perfectly healthy and affluent, struma ought not to be acquired or known. An answer that necessarily involves the consideration of the *means* of prevention.

The means of preventing struma may be classed under the two general heads of *regimen* and *diet*.

First with regard to *regimen*, it may be confidently asserted, that to procure and maintain health, and consequently to prevent the development of struma, *exercise in the open air and sunshine* are absolutely necessary. This is true as regards all ages; but applies with tenfold force to the earlier stages of existence, when the foundations of future good or evil are permanently laid. Now as regards these means, the affluent in general can do as they choose. They can avoid unhealthy localities and rigorous climates, and select the most healthy and genial. They can take as much exercise as circumstances may require in the open air; and

in any mode, on foot, or horseback, or in carriages. The same is true of the other great requisite of health, *diet*. The affluent can command whatever the world produces, both as regards quality and quantity ; they have it in their power, therefore, to select the most appropriate and wholesome articles of food without stint. How does it happen then that the children of the affluent are so often the subjects of strumous disease ? The answer to this question requires no deep research—on the contrary, is often too obvious. The affluent seldom follow the dictates of common sense, but are the willing slaves of foolish conventional customs and fashions. Their children must not bear the healthy sun-burnt aspect which free exposure to light and air alone can give ; they must look pale and interesting.* Their little bodies must be strictly regulated according to the fashion ; they must be exposed here or covered there ; compressed in this place, or loosened in that, by way of improving their appearance and shape. They are not permitted to exercise their lungs and limbs with that freedom so essential to the development and well-being of these organs, and which the joyous hilarity of childhood dictates ; they are expected to be decorous and grave, and to take their formal walks at stated hours and seasons ; while the rest of their time, and by far the greater portion of it, is passed in ill-ventilated nurseries or school-rooms. So with regard to the diet of their children. This among the wealthier classes is too often left to the ignorance or caprice of servants ; or if the parents interfere, it is not unfrequently more for evil than for good ; and from want of knowing better, or from mistaken views, they not only cram their children with all sorts of unwholesome food ; but sometimes even with wine and other fermented liquors,—the bane of incipient and cumulative existence.

Struma abounds among the children of the poor, particularly in large towns, from other causes than those above recited, viz., from constant exposure to a vitiated atmosphere and want of fresh air and sunshine ; from deficient clothing and filth ; from

* With regard to the peculiar browning effects produced by sun and air on the human skin, the observation has been made, that such effects are peculiar to a state of health. Whether this be actually the case I do not pretend to determine ; but I think I have remarked, that highly strumous individuals do not readily become sunburnt.

unwholesome or scanty diet—in short, from all the evils and privations of indigence. Yet with all these disadvantages, if we exclude the children of great towns, it is a question whether struma does not abound less, *ceteris paribus*, among the ill-fed and ill-clothed children of the poor in the country, than among the children of their wealthier neighbours. This remark shows us the infinite importance of fresh air and sunshine above alluded to—an importance even almost surpassing that of diet itself. The children of the poor in the country often subsist on potatoes, oatmeal, &c., almost entirely, and frequently have not enough of these; yet when born of healthy parents, from free exposure to air and light, we see on their dirty cheeks the ruddy brown of vigorous health; and in their active limbs the most perfect symmetry. In such instances, the constant muscular exertion in the open air, keeps the assimilating organs in perfect condition, so as to enable them to appropriate the coarsest materials—materials which in a state of inactivity would never be assimilated at all; or if partially assimilated, would tend rapidly to induce the strumous diathesis.

We have now to briefly consider the second question.—Can struma when inherited or otherwise acquired, be mitigated or removed?

In the preceding pages we have briefly sketched the two elementary extremes of the strumous diathesis, as more especially affecting the assimilating organs; and it may serve to introduce the present part of the subject, to inquire into the condition of the progeny of such strumous dyspeptics.

Unless under the influence of early marriages with healthy individuals, the children of the first class of dyspeptics, if they have any, seldom live to be reared, however favourably circumstanced. If they do survive, they usually become great invalids, and generally die childless; so that a third generation of such a race rarely exists. In the children of strumous individuals, in general the disease shows itself in various ways, sometimes openly in the form of sores, &c., in which case they often survive under favourable circumstances; the sores appearing to act as a safety valve to the system. Most frequently, however, if they attain the period of adolescence, the disease insidiously attacks the lungs, and they die of phthisis, &c. On the other hand, when strumous dyspeptics are drunkards, and particularly when addicted to ardent

spirits, the children usually die of hydrocephalus, or are born idiots. As an instance may be mentioned, a family where out of five children, four were idiots ; and where the fifth after growing up and coming in possession of a large property, became insane !

If, with the strumous diathesis in either of its forms, diseases of the gelatinous and oleaginous tissues likewise exist ; that is to say, if in connexion with struma, a malignant taint, as cancer, &c., be present in the system, as is sometimes the case, all the circumstances are much aggravated. And here it may be remarked, that an inherited syphilitic taint more frequently perhaps than any other cause, lies at the bottom of such complications ; as this most loathsome affection usually fastens on the gelatinous system, as well as on the others ; and thus injures or destroys the very foundations of organic life.

Such are the consequences of inherited struma in our climate, even under the most favourable circumstances ; and the melancholy truth shows how little can be done towards mitigating or warding off its consequences. Still something may be done with this view ; and as the little at our command may be classed as before, under the heads of regimen and diet, the subject may in some measure be considered as already anticipated.

In selecting localities for strumous children, regard must be particularly paid to temperature ; and we may add, dryness. In a warm and dry climate, children cannot be too much in the open air ; but in a cold and variable climate like our own, when out of doors, they must be carefully clothed, so as to obviate as much as possible the effects of sudden changes of temperature. In the summer a residence near the sea is usually recommended ; and bathing, tepid or otherwise, according to circumstances, may be freely resorted to. In the winter, tepid-baths with salt and water, may be still continued with advantage ; provided care be taken to ensure reaction by active friction over the skin, &c. The utmost attention shquld be paid to common functions ; and everything should be done likely to corroborate the system ; and more especially to give tone to the assimilating organs. The approach of puberty is a time of much anxiety in strumous habits, and requires more than ordinary vigilance ; as the system now usually takes on a decided change for good or for evil. The lungs

at this period, as every one knows, are more especially threatened; and too often in spite of our utmost care, become the seat of insidious disease; especially in females in whom the sexual functions are either imperfectly established, or remain undeveloped. Every means therefore that can be safely resorted to, should be used to establish these important functions; among which exercise in the open air, and muscular activity to the point the strength will allow, are most essential.

In adolescence and early manhood, strumous habits are no less liable to suffer than at other ages from the errors we have named. Some, at this period, are too studious and bodily inactive. Others, heedless of consequences, rush into dangerous extremes and dissipations of every kind. In all, the passions bear the chief sway; and their impulses carried to excess in various ways, increase the tendency to disease. Too often, in addition to all these, young men get themselves inoculated with syphilis; the fearful consequences of which in strumous habits, no less than of the remedies required to eradicate them, have been often alluded to in this volume. The happiness therefore, and even the existence of old age, as we have said, must depend on the modes in which individuals conduct themselves in early manhood. If with careless indifference, they plunge into the errors and excesses alluded to, they die prematurely, or only survive to be wretched. If, on the other hand, they are prudent and live carefully, they may not only attain old age, but enjoy it.

In middle and declining age, it is usually too late to look either for change of habits, or for those benefits which a change of habits in earlier life might have secured. The wise of all classes will still continue to pay due regard to regimen and diet. The unwise and wealthy neglecting both, depute to horses' legs the duties of their own; live luxuriously; and envying their wiser neighbours, wonder why they themselves are so wretched. At this period, the wear and tear of mundane inflictions are usually felt more or less by all; but they too often fall with double force on the indigent victims of misfortune; and by rousing into activity latent disease, abbreviate their unhappy existence.

It remains in the last place, to make a few remarks on the diet of those who inherit a strumous diathesis. An infant born of strumous parents, should be nursed by a young and perfectly healthy

country woman, who should be made to take regular exercise, live simply, and *most carefully avoid all fermented liquors*. When such a child has become independent of the nurse, it is often difficult to find a substitute for human milk. The nearest approach to human milk is, perhaps, asses' milk, or diluted cows' milk; which, together with a small quantity of farinaceous food, may be gradually introduced. The farinaceous food recommended is that of wheat, (or in some instances a small quantity of oatmeal may be tried,) either in the shape of biscuit-powder, torrified flour, or sound bread. All low farinaceous matters, arrow-root, potatoes, &c., also sugar, in all its forms, should be most carefully shunned. As the child gets older, some animal decoction, or some tender solid animal food may be given. A very small proportion of well-cooked green vegetable matter may also form part of its diet;* but sweet puddings and pastry of every kind should be shunned. When the child begins to take solids freely, fluids should be more sparingly taken; and large quantities of water should in particular be prohibited during meals. The best time for taking fluids is two or three hours after taking solids. As the child approaches puberty, the proportion of animal matter may be gradually increased, and that of farinaceous matters decreased. At all these periods, food should be strictly regulated both as to quantity and time. No more should be taken at once than, after a proper interval, can be fairly assimilated; and everything in the shape of fermented liquors should still be most rigorously abstained from.

After puberty the same general rules should be kept in view; though in most instances it will be almost impossible at this period to prevent improper things from being taken. A few of the worst however, may yet be avoided, viz., sugar, low farinaceous matters, and fermented liquors. In middle and advanced age, the habits of life are formed, and men, according to the old proverb, have become fools or physicians. The wise, while oppressed by their daily labours, unfavourable perhaps to health, will still live

* I have long considered the green principle of plants almost essential to health, especially in certain affections of the hepatic system. Perhaps the nearest representative of this principle among medicinal substances is the extract of taraxacum, when prepared *without heat*. A little of such prepared extract, may be often mixed with the food of children with advantage, when the hepatic system in particular is deranged.

strictly according to rule; will avoid improper food and wine; will shun the absurd practice of dining at late hours, when the stomach, like the body and mind, has become fatigued and unfit for active duty; will clothe warmly; will, if circumstances permit, reside chiefly in the country, and change their residence frequently. Those who have stated holidays should take a trip, perhaps to another clime; and under the influence of warm weather, and constant change, it is surprising what liberties may be sometimes taken with regard to diet. Thus I have known dyspeptic individuals, who in the winter in this climate would have been nearly poisoned by the use of sour fruits and wines, almost live on these articles while travelling on the continent; and apparently with impunity. This fact is not mentioned for the sake of recommending its adoption. Too great liberties should not be taken in these respects; since there cannot be a doubt that the benefit of the change of air, &c., is in some degree diminished by such innovations.

To enter further into this part of the subject is unnecessary here. The present volume is chiefly devoted to the attention of strumous dyspepsia in all its multiform conditions; and those who are interested in the matter are referred to its pages for details.

We have often mentioned gout and struma in connexion, and it remains, before we close, to make a few remarks on the apparent relations of these two diseases.

Gout and struma we hold to be both affections, chiefly involving the albuminous elements of the body. In both diseases the albuminous principles, though to a certain extent organized, are not raised to the healthy standard, so as to be fitted for appropriation by the living body. In some instances also, particularly in struma, the imperfect albuminous principles perhaps possess a low independent vitality. Instead therefore of becoming component parts of the living body, they either form separate growths, or are deposited as extraneous bodies; and thus by interfering with organic operations, give occasion to the diseases we call struma and gout. So far, in general terms, struma and gout may be supposed to resemble each other in their character and origin; but gout may be considered to differ from struma in the following respects:

We have elsewhere observed, that living organized matters are rarely separated from a healthy body as excrements ;—that a distinct function exists which we have called the *disorganizing function* ;—and that this function operates by denuding the matters to be excreted of their vitality, which is retained ; and separating the excrementitious matters in the form of common chemical compounds. Now in gout this function is more or less perfect ; the albuminous matters being separated in the form of lithic acid, or of some of its compounds : while in struma it is much impaired or altogether ceases to be efficient ; and instead of disorganized materials, albuminous matters, (perhaps in some cases, as we have said, possessing a low independent vitality,) are separated. Gout, therefore, according to this view, may be considered as a step in the same general direction as struma, but not so far advanced.

Gout and struma in different instances, co-exist, not only in every possible degree, but in every possible state of admixture. In gouty subjects, the more or less disorganized matters are thrown on certain textures in parts of the system remote from the centre of circulation, where they excite inflammation and produce the phenomena of gout. At other times they are eliminated by the kidneys in the form of gravel, &c. When struma prevails, on the contrary, the half-organized matters, from their greater affinity to living products, are more apt to attach themselves to vital organs than to the extremities ; and thus constitute the multiform and dangerous varieties of misplaced and atonic gout.

Such, we conceive, are the relations between gouty and strumous diseases—diseases which perhaps *may* be found separate in their pure forms ; but which in most instances exist together. In such complications, when gout prevails, struma is usually less marked ; on the contrary, when struma prevails, gout assumes its most dangerous and unmanageable forms.

Nearly the same remarks are applicable to *rheumatism* ; but rheumatism being an induced disease, attacks all alike. In its *pure* form, however, it chiefly attacks the *healthy* only ; while *strumous* individuals, under the same circumstances, are apt to get what is termed *rheumatic gout*.

CHAPTER IV.

GENERAL OBSERVATIONS ON THE PATHOLOGY OF OLEAGINOUS ASSIMILATION AND SECRETION.

ALTHOUGH the oleaginous aliments and tissues, whether viewed with reference to health or to disease, do not occupy the prominent place of the saccharine and albuminous aliments and tissues; yet as all the more perfect animals involve the oleaginous principle, we may conclude that its presence contributes in some way to the welfare, if not to the very existence, of the animal economy. Moreover, if this inference be taken for granted, we may also infer, that like the other great staminal principles, the assimilation of the oleaginous principle, both primary and secondary, is not only liable to be deranged; but to give occasion to various secondary diseases. Now such derangements and secondary diseases (of the nature of which, we must confess at the outset, we know much less than we ought to ~~now~~) constitute the principal subject of the present inquiry.

The peculiar affections which we shall select as resulting from deranged assimilation of the oleaginous principle are—SECTION *a*, certain affections connected with an *excessive* and *deficient quantity of oleaginous matters* in the system; *obesity* and *leanness*: and SECTION *b*, certain affections connected with the *mal-assimilation of the oleaginous principle*, and producing derangements in the *qualities* of the principle; of which, as a particular illustration, will be given the history of *Biliary concretions, or gall stones.*

SECTION a.—*Of Obesity and Leanness.*

The natural law of the deposition of fat varies considerably at different ages, and in the different sexes. In children and in females, especially in early age, the chief seat of the fatty deposite is in the cellular texture immediately under the skin. During adolescence, the fat has a tendency to disappear from this situation; but, about the middle age, it frequently becomes again deposited not only in the subcutaneous tissues; but also in the neighbourhood of certain internal viscera. In a perfectly healthy individual, however, no abnormal deposition of fat can be supposed to take place, at any age, or in any locality; provided the natural appetites and muscular powers be regulated as they ought. Whenever, therefore, we see an individual unnaturally fat or lean, we may safely conclude that an error exists somewhere; and that such an individual either inherits a propensity to disease, or is producing for himself such a propensity. The chief circumstances which seem to concur in producing derangements of the oleaginous assimilation are the following:

First, an inherited tendency. No one can doubt that certain families have a natural tendency to obesity, which can be often traced through many successive generations. It is curious also to observe how this tendency is varied in different families, and even in different individuals of the same family. Thus in one family we see the children or females possess a striking tendency to *embonpoint*; while the male adults, particularly in advanced age, are as remarkable for their leanness. In another family, directly the reverse may be observed, and the children or females are lean, diseased, and squalid; while the middle-aged adults are conspicuous for their obesity. These, and other variations which might be named, doubtless indicate deviations from the normal state of health, which, if carefully studied, might throw no small light on the nature of many hereditary affections, at present but little known.

Other circumstances which seem to exert considerable in-

fluence on the deposition of fat, are *climate* and *locality*. The inhabitants of low swampy situations in temperate climates are usually remarkable for their bulky flabbiness and propensity to corpulence; while the inhabitants of very hot, and of very cold climates, as well as the inhabitants of mountainous regions, have perhaps less tendency to obesity.* There is this remarkable difference, however, between the inhabitants of hot and of cold climates; the inhabitants of hot climates can scarcely become fat without becoming otherwise diseased; while the inhabitants of cold climates seem not only to derive protection from the influence of the external cold, by the layer of fat with which their bodies may become enveloped; but the superfluous carbon of the fat, by combining with oxygen, during the secondary assimilating processes, has, with some reason, been supposed to contribute to the production of animal heat. Many beautiful provisions illustrative of these observations might be pointed out, did our time and subject permit; we pass on, however, to the consideration of *diet* and *exercise*, two other very important circumstances influencing the deposition of fat in animals.

Healthy individuals who spend their time in sleep, and in bodily and mental indolence, and who partake largely of fat and luxuriant food, and of ale or other strong malt liquors, have at all ages a tendency to become corpulent. This tendency to become corpulent, however, is usually most remarkable about the

* The reader is desired to observe that the *natural* tendency is to be here understood, such as it exists (or ought to exist) in civilised society. Bodily and mental indolence and overfeeding will induce obesity everywhere, and in hot climates, perhaps, even sooner than in cold; of which innumerable disgusting instances are given by travellers among the savages of Africa. As stated, however, in the text, there is reason to believe, that corpulence degenerates into disease, sooner in warm, than in cold climates; particularly in Europeans. On the other hand, although there appears to be naturally little tendency to corpulence in cold climates; but even to ~~Manness~~, on account of the scantiness, and the labour of procuring food; yet mankind, in a savage state, like mere animals, as the Exquimaux, for example, sometimes become fat in cold climates. In these instances the fat appears to serve the useful purpose, by its feeble conducting powers, of causing the retention of the animal heat; and thus of mitigating the effects of the external cold. Perhaps, also, as stated in the text, by combining with oxygen, the carbon or the fat may, in some way, even contribute to the development of heat.

middle period of life, when it is apt to terminate in gout, or some still more formidable disease ; particularly if the individual persists in his indolent and luxurious habits. It is by the practical application of these well-known facts, that animals are fattened for domestic use, and the rationale of the process is sufficiently obvious ; as is also the rationale of certain refinements of cruelty, said to be practised in the fattening of particular animals ; as, for instance, in the fattening of geese, in which the poor animals are immovably fixed in a high temperature, and crammed till their livers become diseased.* We have alluded above to the influence of temperature with reference to corpulence ; and we may now further observe, that as regards diet, temperature, even in the same climate, is a point of considerable importance ; and on a hot day in summer, most individuals would turn with disgust from the fat roast beef, and the greasy mince pies, which they would relish at Christmas. Nature has furnished ample supplies of food appropriate for all climes and seasons ; and when the dietary thus beneficially provided is violated, as, for instance, when large quantities of fatty matter are taken in warm climates or seasons, they invariably produce derangements more especially of the liver ; and the transgressor is sure to be punished for his temerity.

Such are the most prominent circumstances which favour a tendency to obesity in healthy individuals ; there are, however, many instances of obesity which cannot be referred to any of these causes, and in which the tendency must in part be considered as disease. Thus I have seen individuals (chiefly middle aged females) oppressed with fat, whose habits with regard to eating and drinking were very moderate ; and who took as much exercise as most people of their age. Such individuals, to use their common expression, would grow fat on bread and water—an expression apparently not exaggerated. In cases of this kind it is impossible to suppose that all is right ; and the primary organs

* It is probable that in this and many similar instances the poor animals sometimes have their revenge. Indolent and dyspeptic individuals who partake of these diseased and poisonous productions can scarcely be supposed in all instances to assimilate them ; and consequently run considerable risk in inoculating and converting their own livers or other organs into a similar mass of disease.

of assimilation must either convert the greater part of the aliments taken into fatty matter; or the secondary organs of assimilation, from imperfect or suspended action, must fail to do their duty, and thus allow the fat to accumulate. It is probable that both these circumstances co-exist; and that in such cases the secondary assimilating processes are very imperfectly performed. In corroboration of which remark, it may be mentioned, that I have generally observed such unnaturally fat individuals die prematurely of organic disease, in which the liver appeared to be particularly involved. I have also several times seen such an unnatural tendency to obesity connected with diabetes, as formerly mentioned.

"The term *leanness*, as here understood, implies a simple absence of fat; and is not to be confounded with *thinness* and *emaciation*—terms expressing in different degrees the absence, not only of fat, but also of the gelatinous and albuminous tissues. Leanness, like obesity, when extreme, and when it cannot be referred to a satisfactory cause, must be accounted a disease. In such cases, leanness is usually accompanied by more or less of thinness or emaciation—states of the system which, if not explicable on obvious principles, must almost always be considered as morbid.

Leanness, like obesity, depends either on predisposing or on exciting causes. That some individuals have a natural tendency to leanness as others have to obesity, there cannot be a doubt. Moreover, such tendency to leanness often runs in families, and even descends through several generations. The exciting causes of leanness, like those of obesity, may be considered under the heads of climate or locality; and diet and exercise. I know of no climate or locality, the inhabitants of which are naturally lean; except the inhabitants of mountainous regions may be said to be so. Leanness, more than from any other causes, results from deficient or innutritious diet; from the free use of acid liquors, as cider, &c.; from excessive bodily and mental activity; and from a variety of affections capable of deranging or suspending the primary assimilating processes, and thus of cutting off the supplies; the *modus operandi* of all which, and particularly of deficient and innutritious diet, and of excessive bodily exercise, is sufficiently obvious.

Another cause of leanness may consist in a natural imperfection of the faculty of assimilating the oleaginous principle; or, as just stated, such imperfection may be induced by a variety of circumstances. This incapacity of assimilating oleaginous matters shows itself in a variety of ways. Thus there are some individuals whose *stomachs* will not tolerate the least portion of fatty matters; there are others, who, though the stomach may tolerate fat, never fail to subsequently suffer from its use, by what is called *bilious* derangement. Such individuals are usually lean. On the other hand, there are individuals whose stomach will bear any quantity of fat with impunity,* and who yet remain lean; or certainly, at least, do not become fat; however freely they may partake of oleaginous matters. These three conditions of the system undoubtedly depend on very different causes. The two first conditions, in particular, most usually occur in individuals of an anxious and nervous character; of great mental susceptibility and activity; and who, moreover, have suffered much mental affliction, real or imaginary. The first form, in particular, viz. the total incapacity of taking oleaginous matter in any state, I have once or twice seen connected with cerebral disease, which has subsequently proved fatal. In spare individuals, who take fat with impunity, the fat is either not assimilated at all, and passes through the bowels unchanged, as in many strumous individuals; or if the fat be primarily assimilated, the secondary functions dispose of it as fast as it is deposited, so as to prevent its accumulation. This latter more particularly occurs in healthy individuals who take much exercise, or are mentally worried; and who under no system of diet whatever, would become fat. As a general rule, perhaps, it may be finally stated that obesity is connected with haemotrophy, and leanness with anaemotrophy; but the preceding remarks will show that though this rule may be true in extreme instances, yet that, under the common circumstances in which mankind is placed in a state of civilization, there are numerous apparent exceptions to it.*

Although the oleaginous principle, from what has been else-

* It is a popular notion that frequent bleedings favour obesity; and perhaps, by conducing to bodily and mental inactivity, it may do so within certain limits.

where, as well as above, stated, seems to be less subjected to change in the primary assimilating organs than either of the other great alimentary principles, so that it is doubtful whether it be converted by the mere action of the stomach, &c., into albuminous matters; yet the case is very different with respect to the operations of the secondary assimilating processes on this principle. In those important secondary assimilating processes, for instance, which are constantly going on in all organized beings, and which cannot cease for a moment without the destruction of the being, the oleaginous principle obviously plays a very important part. Thus in febrile and other diseases, in which the primary assimilating processes are often entirely suspended, the rapid disappearance of fatty and other matters from the system, and the consequent general emaciation produced, not only show that the secondary assimilating processes are even more active than in health; but that the fatty matter, in common with the other matters, is somehow appropriated to the purposes of the economy. The same appears from the phenomena of hibernating animals, which may be almost said to live on their fat during their dormant state. The exact changes which the fat undergoes during these secondary assimilating processes are unknown; but in whatever these changes consist, they are probably essential to the existence of organic life; and therefore of first-rate importance. That the production of animal heat is the only use of the fat thus disposed of, as recently stated, I do not believe, for reasons elsewhere stated.

That the oleaginous principle, as laid up in the great reservoirs in which it is deposited in animals, partakes less of the characters of a living organized substance than either of the other constituents of which their bodies are composed, cannot be doubted; yet that fat, or some nearly allied principle, admits of the highest degree of organization of which matter is perhaps capable, is evident from the large proportion into which it enters in the nervous and cerebral tissues; one fourth, at least, of the solid matters composing which tissues is said to consist of oleaginous principles. With the oleaginous principles are associated an unusually large proportion of phosphorus and other incidental mineral matters; the use of which, as well as their states of combination, are absolutely unknown to us. The proportion of

the nervous and cerebral masses to the other soft parts of animals is comparatively small, but of course is different in different animals; as a general rule, the proportion is the greatest in the more perfect animals, in whom the brain and nervous system are the largest. Moreover, as the quantity of fatty matter in animals seems to bear an inverse relation to the quantity of bodily and mental, *i. e.* of *nervous* activity; * can the leanness proverbially produced by nervous activity be referred to the more rapid consumption, and consequent renovation from the oleaginous principle, of the general mass of nervous matter? Further, is not extra-consumption of the nervous matter attended by the presence of a larger proportion of phosphorus in the urine? And cannot the occasional appearance of a large proportion of the earthy phosphates in the urine be referred to the same operations? †

We have made these remarks for the sake of bringing together under one point of view the little we know of the general physiology, and particularly of the assimilation, of the oleaginous principle. They are acknowledged to be very imperfect; but the remarks, incomplete as they are, may have the effect of drawing the attention of others to the subject; we shall, moreover, have occasion to refer to some of them in subsequent parts of this volume.

Although obesity and leanness may, as we have seen, become of themselves diseases; yet in all their common modes of existence they are rather to be considered as symptoms only. A formal account of the treatment of obesity and leanness, therefore, is not necessary; and they much more naturally fall to be considered in connexion with those peculiar conditions of the system to which they usually belong as symptoms.

* The reader will observe that the term *nervous* is to be here taken in its most comprehensive sense; that is, as including *all vital acts*, from the lowest automatic, to the highest mental and abstract; every one of which acts is equally accomplished through the medium of different forms of organized nervous matter.

† Since the last edition of this work was published, Dr. Bence Jones has partially investigated some of these points. The general results of his elaborate inquiry will be found at the end of the next chapter.

SECTION b.—*Of Cholesterine and its deposits.*

As an illustration of the Pathology of the oleaginous principle, we shall briefly consider the phenomena and symptoms of that condition of the hepatic system terminating in the formation of biliary concretions; as well as the secondary symptoms arising from the presence of such concretions.

The existence of biliary concretions, and consequently the part they perform in the production of disease, seems to have been unknown to the ancients; and it was not until anatomy began to be practically studied in the seventeenth century, that their existence and connexion with disease appear to have been distinctly recognised.* After their discovery, their pathology attracted considerable attention; but their chemical composition and relations remained unknown till towards the middle of the last century; when the celebrated Haller, I believe, first pointed out the nature and some of the properties of the peculiar substance of which gall stones usually consist. This substance was subsequently examined by others, and particularly by Fourcroy, who confounded it with the principle he named *Adipocere*. At a later period, Chevreul took up the inquiry, and, after determining it to be a principle *sui generis*, gave it the name it now generally bears, viz. *Cholesterine*.

Although cholesterine forms the most usual and abundant ingredient of biliary concretions, yet, as we shall show hereafter, these concretions sometimes consist of other ingredients. The subject, however, has not been studied as it deserves; so that we can neither point out the pathological relations of the different species of concretion, nor even of cholesterine itself, so clearly as could be wished. Indeed, beyond the mere mechanical symptoms and effects produced by these concretions, we know but little; and as the little we do know will appear to the greatest advantage

* Previously to this period, if recognised at all, gall stones appear to have been confounded with the intestinal concretions called by the general term *Bezoars*.

by way of inference from the phenomena; we shall in the first place briefly state the pathological history and symptoms of biliary concretions.

Biliary concretions are most usually found in the gall bladder, or in the common duct communicating with the intestine. They are not, however, confined to these localities, but have been met with in almost every situation to which the bile has access; as for instance, in the cystic duct; in the hepatic and biliary ducts, and their ramifications; in various parts of the intestines; &c. Their more frequent appearance in the gall bladder has been accounted for from the longer sojourn and stagnated state in which the bile exists in that receptacle; but when we consider that the existence of concretions in the gall bladder constitutes the exception rather than the rule; and that their occasional occurrence in the minute ramifications of the bile ducts, can only be explained on the supposition that the biliary principles of which they are formed are in an unnatural and isolated state; we may probably infer, with tolerable certainty, that wherever gall stones exist, the properties of the bile, and consequently the functions of the liver, deviate from the state of health. Moreover, we may generally infer, that when gall stones are found in the intestines, their nuclei at least have been formed in the gall bladder. More frequently, however, on such occasions, the gall stones have had the appearance of being entirely formed in the gall bladder; from whence they have passed to the intestines, either through the expanded common duct, or through an ulcerated opening, in a manner to be presently explained.

The *symptoms* produced by biliary concretions, may be divided into primary and secondary. By primary symptoms are meant those derangements of the health, and more especially of the liver, which give occasion to the formation of gall stones; under the head of secondary symptoms are included all those derangements connected with, or arising from, the mechanical irritation they produce.

The primary symptoms accompanying the formation of gall stones, and dependent on their general pathology, are, as we have said, very imperfectly understood; and if any symptoms peculiarly characteristic of such a state of the system exist, they have been hitherto overlooked; or confounded with the symptoms of

other derangements. On this part of our subject, therefore, we have little to offer ; and the few remarks to be made will be advantageously deferred till we have entered more fully into their history.

The secondary symptoms produced by gall stones actually formed, differ exceedingly according to their locality, magnitude, and a variety of other circumstances ; as the following observations will show.

Unless of unusual magnitude, gall stones give very little uneasiness when quiescent in the gall bladder ; and when they do not obstruct the passage of the bile from that receptacle. Hence gall stones are often found in the gall bladder after death, the presence of which had never been suspected during the lifetime of the patient. When of unusual size, or when a great number of them exist in the gall bladder, patients sometimes complain of a sense of uneasiness in the region of the organ ; the functions of the stomach and bowels are more or less deranged ; the motions become deficient in bile ; and the eyes and general countenance slightly jaundiced ; sometimes there is a sense of fulness and tenderness in the epigastrium ; accompanied by an uneasiness in the region of the liver, which extends through to the right shoulder blade, and occasionally affects more or less the whole of the right side of the abdomen, and even the right arm. This uneasiness is apt to be increased by certain movements of the body ; or by a deep inspiration. When the concretions are very large, or obstruct the passage of the bile so as to cause distension of the gall bladder, the distended organ can in thin persons be sometimes distinctly felt. The constitutional symptoms attendant on the presence of gall stones, and resulting either from their mechanical irritation or from the peculiar diathesis producing them, or most likely from both causes, are, in different individuals, and under different circumstances, very various and anomalous. Sometimes the brain and nervous system in general are particularly affected, and there is headache, vertigo, convulsive starting, cramp, &c. ; the spirits also are unusually depressed ; and there is complete hypochondriasis. At other times the assimilating organs more especially suffer ; and in connexion with a greater or less degree of the nervous symptoms, there is obstinate dyspepsia, particularly marked by great acidity of the stomach ; and

a colicky, irregular condition of the bowels. There is frequently congestion of the abdominal viscera, with a tendency to haemorrhoids : and in females the catamenia are apt to become disordered, being either in excess, or in the opposite extreme, or even altogether suppressed. The urinary organs often become more particularly involved : the urine is not only loaded with bile, but is occasionally serous ; or deposits large quantities of lithic acid gravel, &c. The bladder often participates in the derangement, becomes highly irritable, and its inner membrane throws off much mucus ; at other times the mucous membrane is but little affected, and the urine is limpid and colourless, and voided in inordinate quantity. I have seen several instances of biliary concretion, in which the urinary derangements have become so prominent as to exclude the other symptoms ; so that the true nature of the disease has been overlooked. Thus many years ago I attended a patient for a supposed urinary affection which disappeared after an attack of gall stones, the existence of which had not been suspected. In this case the urine was copious, almost limpid, and constantly serous ; there was considerable irritation of the bladder, particularly towards the morning ; a dull uneasy sensation was also felt about the region of the kidneys, and the functions of the stomach and bowels were much disturbed. All these and other symptoms, however, apparently indicating renal affection, to my surprise, either left or ceased to trouble my patient after a severe attack of jaundice, accompanied by the passage of gall stones. In this case, a great tendency to disease, if not actual incipient disease of the kidneys, was excited, or perhaps produced, by a remote mechanical irritant. Nor can there be any reason to doubt, that if this exciting cause had not been removed, the disease of the kidneys would have become confirmed and taken its usual course. I am unable to state whether the urine entirely recovered its healthy condition, or having recovercd its healthy condition, whether it still retains such condition ; but the patient, now far advanced in years, is alive, and apparently well. Such are the symptoms most commonly accompanying the presence of concretions in the gall bladder. During the passage of these concretions from the gall bladder to the intestines, another and much more formidable train of symptoms is usually produced, which we have in the next place to consider.

The symptoms produced by the passage of gall stones from the gall bladder are generally sudden in their invasion : severe both in kind and degree ; and for the most part assume the paroxysmal form. The attacks usually commence two or three hours after eating, with uneasiness and pain in the region of the gall bladder, which rapidly increase, and at length become so excruciating that the patient is almost bent double ; or rolls about the room in agony ; or sometimes falls into a state of syncope. The pain is usually somewhat mitigated by pressure ; hence the hands are instinctively and forcibly applied to the epigastrium. To this severe state of suffering, there is superadded the most distressing nausea and tendency to vomiting ; and the matters ejected are intensely acid or bitter. The stomach and bowels are distended with flatulence, which sometimes produces painful cholic ; there is usually a tendency to constipation ; and the motions, whether naturally or artificially produced, on account of the obstruction of the biliary secretion, are always clay-coloured and deficient in bile. The paroxysms are of uncertain duration ; sometimes lasting for a few hours only, at other times extending over several days, with intervals of comparative remission from suffering ; but in almost all instances, especially when the attacks last for a considerable time or are unusually severe, or repeatedly occur at short intervals, the system becomes surcharged with bile ; and there is either complete jaundice, or the eyes at least assume a yellowish tinge. The urine also becomes scanty, and loaded with bile ; and occasionally there is considerable irritation about the bladder. During the whole of this time the pulse is scarcely affected, and there is no fever ; except in violent and protracted cases, when the tongue becomes loaded ; there is loss of flesh and strength ; and the epigastric region becomes tender to the touch, showing incipient inflammatory action. In favourable cases the attacks usually terminate as suddenly as they began, the moment the gall stone has escaped into the intestines ; and if there be no repetition of the paroxysm, the patient speedily recovers his former health and spirits.

Biliary concretions, from the mechanical irritation they produce often give occasion to various forms of organic derangement or disease. Of such effects, innumerable instances are related by different authors ; but the following are among the most usual and remarkable :

Perhaps one of the most frequent, as well as favourable effects produced by biliary calculi, is dilatation of the biliary, and particularly of the common duct; by which not only the exit of concretions already formed, but of those that may be formed hereafter, is promoted; and thus much of the suffering which would have been induced by them, is consequently prevented. When we consider the small size of the common duct in its healthy state, the extent to which its dilatation is sometimes carried seems almost incredible, were the facts not well authenticated. Thus the celebrated Morgagni relates a case in which he found the diameter of the common duct dilated to nearly two fingers' breadth; and many instances are recorded, in which the duct has been found large enough to admit the finger. Another effect of biliary concretions, which proves speedily fatal, is rupture of the gall bladder. In such instances, the passage of, the bile has been observed to be completely obstructed by the gall stone; and the bile, by accumulating in the gall bladder, has caused this organ to become so distended, that its coats have suddenly given way; generally during a severe fit of vomiting. Other effects produced by gall stones, particularly when of large size, or very numerous, are inflammation and ulceration, not only of the gall bladder and its appendages, but of contiguous viscera. On such occasions, adhesions occasionally take place between the gall bladder or its ducts, and different internal cavities; or sometimes even between the gall bladder and the external parietes of the abdomen. These adhesions favour the exit of the concretions; which gradually make their way by an ulcerative process through the adhering parts, and thus finally escape into the stomach, colon, cavity of the abdomen, &c.; or even occasionally at the external surface of the body, through openings in the epigastrium, the umbilicus, &c.; instances of all which, as well as of other remarkable escapes of biliary concretions, are mentioned by different authors.

Nor are these the only secondary effects produced by biliary concretions; for in some instances, when they have left the gall bladder and passed into the intestines, by subsequently obstructing and otherwise interfering with the functions of this canal, they give occasion to many distressing symptoms. When of small, or moderate size, they produce little inconvenience during their

passage down the canal, besides temporary constipation, colic, tenesmus, &c.; but when of large size, they sometimes lodge in various parts; particularly in the cæcum, or in the sigmoid flexure of the colon, or in the rectum, where they cause obstruction, terminating in inflammation, &c., and thus not only endanger, but even destroy the life of the patient. Instances are also recorded in which biliary concretions impacted in the cæcum, &c., have produced ulceration, and been discharged externally.

Causes.—The general pathology and peculiar conditions of the system predisposing to, or inducing the formation of biliary concretions, have, as already stated, been imperfectly studied, and consequently are not well understood. The little that is known, chiefly applies to the variety of concretion consisting of cholesterine, to which, therefore, our observations will be principally directed.

That cholesterine is connected with the oleaginous principle is evident from its chemical properties and composition; indeed it contains a larger proportion of carbon than any known crystallisable solid in which likewise both oxygen and hydrogen exist. Cholesterine, as formerly noticed, is said to be an ingredient of healthy bile, as the lithic acid is of the urine; and like the lithic acid, in the healthy condition of that secretion, seems to be retained in a state of solution. The nature of this state of solution, however, is not known; but in certain diseases it appears to be imperfect or deranged, and the cholesterine, set free from its solvent, becomes developed in its pure and crystallised form, and thus gives occasion to biliary concretions; precisely as in certain conditions of the system, the lithic acid is set free and gives occasion to urinary concretions. Cholesterine also, like lithic acid, is found in places remote from the organ where it is supposed to be principally developed; as, for instance, in cavities and cysts in various parts of the body, the contents of which have been long pent-up and retained in a passive state. In such cases, the cholesterine has been probably developed on the spot from the oleaginous principle; and not formed in, or by, the agency of the hepatic system—a circumstance which seems to throw light on the development of this principle in the liver itself.

Biliary concretions are of very rare occurrence before the ^{age} of puberty; and indeed are seldom met with before the ^{middle} of

decline of life. They are so much more common in females than in males, that we sometimes see four or five cases in women, for one in men. They occur most frequently in corpulent individuals who live fully, take but little exercise, and spend much of their time in sleep. Such habits, together, perhaps, with a peculiar predisposition to derangements of the assimilating processes, favour dyspepsia in all its forms; and particularly a torpid and congested condition of the hepatic system. It has been supposed that those who more particularly suffer from lithic acid deposites, are less liable to biliary concretions; but were I to judge from my own experience, I should say that this opinion is not well founded; and that the two states of disease often go together. Indeed, I have seen few cases of biliary concretions, in which the urinary organs have not in some way been seriously deranged. The popular notion, that urinary calculi are more frequent in men, and biliary concretions in women, on which the above opinion seems to be founded, probably arises more from accidental circumstances than reality. The reasons why women are less subject to urinary calculi than men, are obviously mechanical; and have no reference to the frequency or infrequency of the calculous diathesis. For even supposing the tendency to calculous deposites in the two sexes to be the same, the reasonable inference must be, that men will be much more likely to suffer from stone in the bladder, than women. While, therefore, it must be admitted that women are more subject to gall stones than men; this admission proves nothing with regard to the equally admitted fact, that men are more liable to urinary concretions than women; because this latter fact can be otherwise satisfactorily explained; even supposing the tendencies to urinary derangements in the two sexes to be equal. The real question is, whether women, were they not thus favoured by natural conformation, would not be more subject than men to urinary concretions, as they are admitted to be to biliary concretions? This question in the present state of our knowledge cannot, and probably never will, be satisfactorily answered; but my belief is, that, *ceteris paribus*, women would be at least as liable to urinary concretions as men.

Biliary concretions, though occasionally, are not necessarily, connected with diseased livers. Many instances occur of biliary concretions, in which the structure of the liver is not visibly de-

ranged ; while, on the other hand, innumerable cases of diseased liver occur, in which biliary concretions do not exist. In this respect we have another analogy between cholesterine and lithic acid ; lithic acid, as we formerly stated, not being necessarily connected with a diseased kidney. Further, the very condition (*hæmotrophy*) of the system favouring the development of lithic acid, seems also to favour the development of cholesterine ; for, as lithic acid is seldom found in the anæmotrophied kidney, of which the granulated kidney of Dr. Bright may be considered as an extreme instance ; so deposits of cholesterine, I believe, are seldom found in the corresponding states of the hepatic system produced by the abuse of ardent spirits.

On the whole, then, we may conclude that cholesterine concretions arise from, or are connected with, the imperfect assimilation, primary and secondary, of the oleaginous principle ; and a retarded and sluggish action of the liver—circumstances most frequently associated with a peculiar *hæmotrophied* condition of the body, produced and aggravated by a full diet ; by the use of generous wines and malt liquors ; by muscular inactivity, and too much sleep ; and perhaps, in some instances, by certain modifications or degrees of malarious influence ; the effects of which on the hepatic, in common with the system in general, are well known. Finally, it is not improbable that the greater tendency of females to biliary concretions, arises in part from their being exposed in a greater degree than males to some of the predisposing, as well as of the exciting causes above mentioned.*

Diagnosis.—The mere existence of biliary concretions in the gall bladder or elsewhere, when quiescent, can scarcely be satisfactorily inferred from any characteristic symptoms. Even when they produce those peculiar symptoms usually attendant on their passage through the ducts, &c., these symptoms are often so mixed up with, or masked by, other symptoms, that it is not easy in all instances to pronounce a decided opinion. I have several times known attacks of gall stones confounded with nephritis attacks, and *vice versa* ; so nearly, in some instances, do the two affections correspond with each other. When jaun-

* I have recently seen a case of gall stones in a young and healthy man, in which the affection was apparently produced by chronic inflammation of the liver, caused by a violent concussion of that organ.

dice appears, the liver must be involved in some way, and if the other symptoms favour the supposition, we may conceive the jaundice to depend on gall stones; but the absence of jaundice does not prove the absence of biliary concretions, which may exist without producing jaundice. Much may be learnt from the preceding history and general circumstances of the patient; and indeed, without a knowledge of these facts, we are unable in the great majority of cases to arrive at satisfactory conclusions.

The *Prognosis* in biliary concretions is as uncertain and difficult as the diagnosis. Innumerable instances occur, in which gall stones are found after death, the existence of which had given occasion to no uneasiness, or been even suspected, during the life of the individual. The mere presence of gall stones, therefore, abstractedly considered, cannot be considered dangerous. The danger from gall stones arises from their number or magnitude; from the degree of irritation or disorganization they produce; in short, from the interruption or impediments they may occasion to the functions of life; which interruptions are sometimes so serious as to render gall stones one of the most formidable diseases to which humanity is liable.

Treatment.—The treatment of gall stones is naturally divided into two distinct branches, viz. the treatment having reference to the peculiar diathesis or constitutional symptoms causing their formation; and the treatment having reference to the mechanical or secondary effects produced by them.

When a tendency to biliary concretions, or their actual existence in the gall bladder is suspected, the following are among the principal means usually recommended. The continental writers in general reprobate the use of mercurial remedies in these affections, principally, I believe, on the grounds, that the evil is likely to be increased by exciting a flow of bile, when an impediment to its escape exists; or that by propelling the concretions into the ducts, they may cause such impediment. If actual obstruction of the gall ducts exist, or if there be symptoms denoting organic disease of the liver, mercurial remedies must certainly be given with great caution, or be altogether avoided; as under such circumstances there can be little doubt that they are calculated to do great and irreparable mischief. But when neither

of these circumstances are present, and the affection appears to be purely functional, as indicated by a deranged condition of the bile, rather than by a deficiency of the secretion ; there can be no objection to a cautious use of the remedy ; and indeed, under such circumstances, I have seen more benefit derived from mercury, than from all other remedies put together. To be effective, the remedy should be given in very small doses, for a considerable time, in conjunction with taraxacum, or some analogous deobstruent. The effects must be carefully watched ; and if jaundice supervenes, the remedy may be intermittent, or conjoined with some sedative, as henbane or opium ; provided the cause of the jaundice, as it often does, depends chiefly on spasm of the ducts. If, however, there be reason, from the obstinacy of the symptoms, or other circumstances, to suspect permanent mechanical obstruction of the ducts, the mercury must be suspended altogether, and the other means commonly resorted to, applied ; such is the taraxacum before mentioned ; also the alkaline carbonates, the muriate of ammonia, borax, the acetate of potash, Castile soap.* &c. To these may be added sulphuric æther, or combinations of this with turpentine, &c. ; a class of remedies strongly recommended by some continental physicians, but not much employed, I believe, in this country ; at least, I can speak very little of their effects from my own experience. With these means, gentle laxatives calculated to ensure regularity both of the secreting and mechanical functions of the bowels, should be employed ; such as the *Decoct. aloes comp.*, or, in some instances, small doses of castor or olive oil, manna, &c. In other instances, and at particular periods of the affection, a gentle course of the Cheltenham or Leamington saline waters may be recommended with advantage ; while there are a few obstinate cases, which, after resisting every means we can devise in this country, will be much relieved by some of the continental waters ; particularly those of

* Castile soap has been particularly recommended in this affection ; but the good effects of the remedy can depend only on the alkali present, which will probably be more efficient given alone. When we consider, also, that the oily principle of the soap is reduced by the process of saponification into a substance analogous to cholesterine, or at least capable of assuming the crystallised form ; the propriety of administering soap in large quantities becomes still more doubtful.

Carlsbad. With respect, however, to the purgative class of remedies in general, it may be observed, that the same rule is applicable to them as to mercury, and for the same reasons; viz. that while gentle laxatives are necessary and beneficial, strong purgatives, by too much exciting the action of the hepatic system, and thus by forcing the concretions into the ducts, have often a tendency to increase biliary obstruction, rather than to remove it.

Whether there be any remedies possessing the power of *dissolving* biliary concretions, I am unable to state. The ætherial and turpentine class of remedies above mentioned, were first, I believe, chiefly recommended on this supposition; but their effects in this way seem to be more than doubtful. Cholesterine, as we have stated, appears to be held in solution in healthy bile, by some unknown principle. The most probable mode, therefore, of dissolving concretions of this substance in the gall bladder, is to promote a permanently healthy condition of the bile; and thus, by constantly keeping the solvent principle in contact with the concretion, we may hope in time to gradually dissolve it; or at least to cause its disintegration. I mention this circumstance with the view of stating, that within the last few years I cannot help thinking that I have seen two or three instances of such a dissolution of gall stones under the plan of treatment mentioned. In these instances, the symptoms of gall stones, which were strong, unequivocal, and of years' duration, gradually and entirely subsided after a steady perseverance, for many months, in a gentle course of alteratives and decoctives; and my belief, from various circumstances, was, (particularly in one of the instances,) that the gall stones became either softened or disintegrated, so as to pass away with little inconvenience to the patient.

We have now to make a few remarks on the means to be adopted during a paroxysm produced by the passage of gall stones into the intestines.

The great and almost the only means of relief during severe paroxysms of pain from gall stones, is opium. The urgent and distressing vomiting usually present, prevents fluid medicines from staying on the stomach; hence opium is generally best exhibited in a full dose, in the form of a pill; either alone, or com-

bined with calomel, as circumstances may appear to indicate. In other instances, medicines of the effervescent kind, combined with opium, will be beneficial. The sulphuric ether variously associated, particularly with opium, is a favourite remedy with some practitioners, and occasionally the remedy apparently affords relief. I have seen more immediate alleviation afforded by large draughts of hot water, containing the carbonate of soda in solution, (in the proportion of from one to two drams of the carbonate to a pint of water,) than by any other means. The alkali counteracts the distressing symptoms produced by the acidity of the stomach; while the hot water acts like a fomentation to the seat of the pain. The first portions of water are commonly rejected almost immediately; but others may be repeatedly taken; and after some time, it will be usually found that the pain will become less, and the water be retained. Another advantage of this plan of treatment is, that the water abates the severity of the retching; which is usually most severe and dangerous, when there is nothing present on which the stomach can react. This plan does not supersede the use of opium, which may be given in any way deemed most desirable; and in some instances, a few drops of laudanum may be advantageously conjoined with the alkaline solution, after it has been once or twice rejected.

In connexion with the preceding internal expedients, warm or sedative applications in the shape of poultice, fomentation, &c., may be applied externally to the seat of the pain; of such applications, a large and warm linseed poultice, sprinkled over with laudanum or camphor liniment, or a mixture of the two, may be adduced as an instance. On the other hand, instead of warm, some have strongly advocated the use of cold, expedients, *e. g.* the constant application of a bladder of pounded ice to the seat of pain; and a great many instances are mentioned, in which this mode of practice has proved successful. Bloodletting either general or local is seldom indicated; yet if there be great tenderness in the region of the gall bladder, and the pulse, &c., denote a tendency to inflammatory action, leeching, or sometimes blistering, may be occasionally resorted to with great advantage.

When the symptoms indicate that the concretions have passed into the intestines, laxatives, injections, &c., should be perseveringly applied till they be evacuated; and as ocular evidence of

this fact is always desirable, directions should be given to mix the fæces with water, so as to separate all the portions miscible with that fluid. When the concretions are of large size, and lodge, as they sometimes do, in the intestines, particularly in the cæcum, the same expedients, varied according to circumstances, will be proper; but if the concretions get impacted into the rectum, or anywhere within the reach of instruments, mechanical aid, in addition to the other means, must be resorted to for their speedy removal.

After everything that medicines can do for the patient has been accomplished, he should be put on a rigid plan of diet, exercise, &c., with the view of preventing future attacks. With respect to diet, this should consist principally of those animal, farinaceous and herbaceous matters, which are light and easy of digestion; but the oleaginous principle, in every form, should as much as possible be excluded; hence butter, chocolate, fat meats, &c., should be altogether shunned. The necessity of avoiding too much sleep, and indolent habits in general, should be particularly insisted on; hence early rising, and plenty of exercise, both on foot and horseback, should be recommended; and to ensure these, if the circumstances of the patient permit, he should be advised to travel; and to take the opportunity this would afford him, of trying the effects of one or more of the numerous continental mineral waters adapted to his case.

The preceding observations apply chiefly, as we stated, to the most common variety of gall stones, those namely composed of *cholesterine*.

I have seen three instances of gall stones, composed of the *colouring matter* of the bile in nearly a pure state. In each of these cases, the affection has been marked by great derangements of the assimilating organs; but in no other respect did they appear to present anything in common. They all occurred in men, of whom two were middle-aged; the other advanced in life. In

two of the instances the concretions appeared to be solitary ; and since their expulsion there has been no sign of return for several years. The third case proved fatal by ulceration of the gall-bladder ; in which organ and the abscess communicating with it, a great number of concretions of all sizes, from that of a nut to a mustard-seed, and all consisting of the same substance, were found on examining the body after death. On the whole, from the little I have seen of this rare form of disease, I am disposed to think unfavourably of its character.

With respect to the pathology of gall stones, composed of what has been called *inspissated bile*, &c. little is known. Nor am I aware that their existence can be distinguished by any peculiar symptoms. I mention the subject with the view of observing, that while I have noticed cholesterol concretions to be most usually associated with the appearance of lithic acid in the urine ; I have fancied that I have found the concretions composed of dark coloured inspissated biliary matter to be associated with a tendency to the formation of oxalic acid and to malignant disease, more especially of the liver. On these matters, however, I wish it to be at present understood that I make no assertions ; but simply throw out the hint for future inquirers.

For the reasons stated at the commencement of this chapter, as well as for the additional reason that most of the diseases fall without my design, I shall not attempt to enter further, in this place, on the pathology of the oleaginous principle. The subject, however, in many points of view, is one of great importance ; as I am satisfied, from long attention to the matter, that the oleaginous principle is much more deeply implicated, not only in the operations of organic life, but in those higher operations connected with the animal functions, than is commonly supposed. If such be the case, its pathology must be commensurate ; and I venture to foretell that this will hereafter prove to be the case ; and that some of the most formidable diseases to which animal existence is liable, will be found to be connected with, or to result from, the mal-assimilation of the oleaginous principle. Should no one else pursue the investigation, I may at some future time publish a few remarks on the subject ; but to follow it out in its details, is the business of a lifetime ; and as our pro-

fession is at present circumstanced, such an attempt can be only satisfactorily made during the ardour and comparative leisure of youth.*

* In the short interval since this was written, the conjecture here advanced has been abundantly verified. As instances, we may refer to what has been said on fatty degeneration of the kidney, struma, &c. But diseases, if possible, even more important than these, will be hereafter found associated with mal-assimilation of the oleaginous principle.

CHAPTER V.

GENERAL OBSERVATIONS ON THE PATHOLOGY OF THE INCIDENTAL MATTERS OF ORGANIZED PRODUCTS.

WE come now to consider a formidable class of diseases, whether we view them with relation to the peculiar constitutional disorders with which they are associated ; or with reference to the secondary diseases to which they give occasion in the urinary and other organs, viz. the diseases connected with, or arising from, the incidental matters existing in organized products.

These diseases we shall consider under two heads or Subspecies, namely,—Subspecies *a*. *Diseases connected with insoluble incidental matters, including the triple phosphate of magnesia and ammonia, and the phosphate of lime*; and Subspecies *b*. *Diseases connected with the soluble incidental matters, including soda and potash*; to which may be added, *ammonia*. As on a former occasion, however, and for similar reasons, the *phenomena, symptoms, and causes*, only, of these two Subspecies, will be considered under separate heads ; the *General diagnosis, prognosis, and treatment* of the two Subspecies, will be then spoken of in conjunction.

Before we proceed it may not be improper to direct the attention of the reader to a fact of great importance with regard to the deposition of the phosphates in the urine ; and which from having been unattended to, has given occasion to needless discussions and mistakes. A *deposition* of the phosphates in the urine does not necessarily imply an *excess* of the phosphates ; any more than a *deposition* of the lithic acid denotes an *excess* of lithic acid in that secretion. We have already pointed out that a peculiar (acid)

condition of the urine sometimes causes a deposition of every particle of lithic acid in that secretion, though the quantity of lithic acid may be even *less* than natural; so with regard to the phosphates, a peculiar (alkalescent) condition of the urine sometimes causes a complete deposition of the earthy phosphates, though their actual quantity may be even *less* than natural.

Subspecies *a.* *Of the diseases connected with the insoluble incidental matters, the triple phosphate of magnesia and ammonia, and the phosphate of lime.* In a perfectly healthy condition of the system, the earthy phosphates incidentally necessary to the existence of all organized bodies, and resulting from their decay or mal-assimilation, are everywhere eliminated from the economy in a state of solution. In certain constitutional diseases, however, the balance of the healthy and natural affinities is broken, and the phosphates are deposited in the urine, and in other parts of the body, in the solid state; and thus give occasion to various distressing secondary diseases, to be now considered. The phosphatic salts more especially claiming our attention at present, are the triple phosphate of magnesia and ammonia, and the phosphate of lime; and as the constitutional symptoms as well as the immediate origin of these two compounds appear to be somewhat different, they require a separate consideration.

The *triple phosphate of magnesia and ammonia* is usually deposited from the urine in the form of perfectly white shining crystals, and constitutes what is denominated *white gravel*; in contradistinction to the lithic acid crystals, which, from their colour, is termed *red gravel*. The white form of gravel sometimes occurs alone, but very frequently it alternates with, or is accompanied by, the pale coloured lithic amorphous sediments; or the amorphous variety of phosphatic sediment, to be presently described.

The urine depositing the triple phosphate of magnesia and ammonia is generally pale coloured, and very slightly acescent when passed. For the most part also it is abundant in quantity, and of moderate or low specific gravity. On being exposed to the air for a short time, it gradually becomes alkalescent at the surface, even in some instances before it is cold; and on such occasions a superficial iridescent pellicle is usually formed, which, on examination, proves to be crystallised, and to consist chiefly of the

triple phosphatic salt in question. About the same time, also, minute crystals of the salt begin to attach themselves to the sides of the vessel in which the urine has stood for a short time ; and the urine speedily becomes alkaline and putrescent. In some instances the urine abounding in this salt is deep coloured, and of considerable specific gravity. When this salt is present in large quantities, the urine is occasionally alkalescent when voided. In such cases, the salt is sometimes deposited, before the urine is discharged from the bladder, and (usually enveloped in mucus) immediately subsides to the bottom of the vessel in which the urine is passed. The period of time elapsing before the urine becomes alkaline, enables us to form a rude estimate of the severity of the disease ; that is, other things being equal, the sooner the urine becomes alkalescent after being passed from the bladder, the more decided the disease. The properties of the urine will be further considered, when we come to speak of the deposition of the mixed phosphates.

The constitutional symptoms, in well-marked instances of the triple phosphate deposite are characterised by what, for want of a better term, we must denominate nervous irritability. This nervous irritability is displayed in various ways, according to the idiosyncracy of the patient. In some individuals it assumes the form of spasm of the respiratory organs, more or less resembling asthma. In others, it shows itself in the form of a spasmodic or excessive peristaltic action of the bowels, accompanied by borborygmi and flatulence ; and sometimes by copious exhausting semifluid motions, &c. In all instances, especially where the diathesis assumes a permanent character, there is more or less of a sense of debility ; and of sinking or exhaustion ; with fatigue and pain in the back, on the slightest exertion. These and analogous symptoms exist in every possible form and degree in different instances. The severer forms of these affections, however, generally occur only when the mixed phosphates are deposited ; they will, therefore, be considered hereafter.

Causes.—A *predisposition* to this affection depending on natural conformation, is often innate or inherited. But whether the tendency be innate or acquired, the delicate and feeble are the most susceptible of the affection. Thus a disposition to deposit the triple phosphate is often present, or is easily induced, in the urine of those who have been long in bad health ; and in whom

the constitution may be considered as giving way, or, to use a common expression, breaking up. The condition of childhood also seems to predispose to this affection; for children in general, either from their natural irritability, or from the derangement of the digestive organs to which they are subject, are liable from the slightest causes to have this deposit in the urine. With respect to the *exciting* causes, these are various; but they all partake more or less of the reducing character. Thus causes unfavourably affecting the system in general, and producing what is termed nervous derangement; as the depressing passions, and particularly mental anxiety or fear, will, in many predisposed individuals, cause a deposition of the triple phosphate in the urine. The same is also true of many articles of food and of medicine, which produce a hurried secretion of the urine, and act as diureties; such as the neutral salts in some instances, and particularly the Rochelle and other saline compounds, in which the acid is of vegetable origin, or destructible. So also the long-continued use or abuse of alkaline remedies, and of mercury, will, in irritable habits, produce a tendency to an excess of this salt, as well as of the phosphates in general; and even lead to their deposition in the urine. Other exciting causes will be mentioned, when we come to speak of the mixed phosphates. In the mean time, with respect to the *proximate* cause of this form of deposit, we may be said to know little. That the deposition of this salt in excess is connected with the inordinate consumption or mal-assimilation of some tissue intimately connected (I do not say *identical*) with the organic system of nerves, is evident from all its pathological relations; and more especially from its extraordinary development during excessive activity, not of growing and increasing, but of common and necessary organic operations. When the triple phosphate is deposited in large quantity, the material of this tissue (probably in a modified form) is often likewise present in the urine in large quantity. It is usually confounded with mucus; but it is quite distinct from the ordinary or diseased mucus of the bladder, or of any of the urinary passages, that I am acquainted with. I have for many years been quite familiar with this form of animal matter; and of late I believe it has been noticed and described by a continental writer, who has given it some arbitrary appellation, which I neither remember, nor

am at present able to refer to ; but which, as far as my memory serves me, has no reference to its true pathological relations.

The *phosphate of lime* is deposited from the urine in the form of an impalpable amorphous powder, which is generally white ; though occasionally it is slightly tinged with the colouring matters of the urine. The properties of the secretion depositing the phosphate of lime are various. In a few instances, I have seen deep coloured, acescent urine, of a specific gravity above 1.030, and possessing all the sensible qualities of urine in an exalted degree, deposit phosphate of lime in large quantity ; indeed urine depositing this salt is not unfrequently acescent, at least when passed. In the greater number of instances, the urine is rather pale coloured, and of moderate or low specific gravity ; and the phosphate of lime is often so abundant as to be deposited on exposing it to heat, notwithstanding its apparent acid reaction ; which even remains after the urine has been boiled.* Urine, however, abounding in the phosphate of lime generally becomes alkaliescent sooner than healthy urine.

The constitutional symptoms accompanying the deposition of the phosphate of lime partake of the irritable character of those accompanying the deposition of the triple phosphate ; but they are I believe much less strongly marked, and exhibit some characteristic differences. In the instances above alluded to, in which the urine was high coloured, and of considerable specific gravity, the patients were decidedly gouty ; and the deposition took place either during, or immediately after, an attack of gout. In many other instances, also, in which the urine depositing the phosphates has been of low specific gravity, the patients have been subject to gout or rheumatism ; or have inherited a tendency to these affections. In these latter cases, however, there has been usually likewise present a peculiar cachectic state of the system, manifested by cutaneous eruptions of a scaly or leprous character. These eruptions have appeared in various parts of the body ; but

*The same phenomena in a somewhat modified form take place when urine containing the triple phosphate in excess is submitted to heat. As elsewhere stated, I was long acquainted with these phenomena, before they were publicly pointed out by Dr. Bird.

they have most frequently occupied the inner parts of the thighs and scrotum ; and when the eruptions have been in these parts, there has been usually more or less of irritation about the urinary organs, with which the external appearance of the eruptive disease appeared to alternate ; that is to say, the urinary affection has become better, as the cutaneous affection has become worse, and *vice versa*. In all these cases the urine has abounded in the phosphate of lime ; and in many of them the patient has occasionally suffered from nephritic attacks produced by concretions formed either of the phosphate, carbonate, or oxalate of lime ; and sometimes by a mixture of all the three salts.*

The *causes* predisposing to a deposition of the phosphate of lime seem to be generally inherited ; and to consist in a peculiar cachectic state of the system, into which gout and struma often enter as elements. I have sometimes thought also, that an inherited syphilitic taint frequently constitutes another element of this peculiar cachexia ; at any rate, I have very often seen the deposition of the phosphate of lime associated with a remote, but obvious syphilitic taint. Long continued bad health, arising from bodily infirmity or mental anxiety, especially when conjoined with the other predisposing causes, seem occasionally to add to their intensity ; and under such strong predisposition, a variety of circumstances having no apparent connexion will often act as exciting causes. In some instances, the affection seems to add to their intensity ; and under such strong predisposition, a variety of circumstances having no apparent connexion will often act as exciting causes. In some instances, the affection seems to pervade more or less, the whole system, and deposits of phosphate of lime take place simultaneously in many parts of the body. In the greater number of instances, however, the deposition is determined by local causes, acting as irritants ; or exciting that peculiar chronic degenerating process, in certain tissues, which seems immediately essential to the deposition of the earthy matter. This is, perhaps, the reason why the deposition more commonly takes place in the urinary and sexual organs, than in other parts of the system—these organs being more liable to

* The oxalate, carbonate, and phosphate of lime are often intermixed, or appear to merge into each other ; probably on account of the relations alluded to in a subsequent note.

be abused, and to be more frequently inoculated with morbid poisons than all of the rest of the body put together. A deposition of the phosphate of lime may perhaps take place in various tissues ; but that form of deposition we are now more especially considering, seems to be generally associated with a tissue common both to the skin and to the mucous membranes. Thus the mucous membrane lining the bladder, the cavities of the kidney, prostate, &c., often throw off immense quantities of the phosphate and carbonate of lime ; and from the mucous membrane of the bladder in particular, much of the phosphate of lime usually found in urinary deposits is derived. The remainder is separated by the mucous membrane lining the cavities of the kidneys, or perhaps by the kidneys themselves ; the quantity naturally secreted by these organs being apparently liable to be much augmented during the peculiar condition of the system above mentioned. I do not pretend to define at present the exact nature or relations of the tissue, during the mal-assimilation or destruction of which the phosphate of lime is eliminated ; but have no hesitation in saying that it is totally different from the tissue above alluded to, from which the triple phosphate is eliminated. The tissue from which the triple phosphate is eliminated appears to belong to the albuminous class ; while the tissue from which the phosphate of lime is eliminated seems to have more relation to the dermoid variety of the gelatinous tissues.*

We have given the above sketch of the prominent phenomena and symptoms, distinguishing the deposites of the triple phos-

* I have elsewhere given my opinion, that the phosphorus in organized beings is in some manner immediately connected with the nervous tissue and nervous action ; and if this view be correct, the *magnesia* of the triple phosphate will *alone* be characteristic of the albuminous tissue formerly described ; while the *lime* of the phosphate will, on the other hand, be characteristic of the gelatinous tissue above noticed. As corroborative of this view, I may state that I have seen several instances in which phosphoric acid has abounded, without an excess of earthy matters ; and have no doubt, therefore, of the existence of such a condition of the system ; though I am not prepared to enter on the subject so completely as I could wish. Lastly, whether the above views be admitted, or whether with some we suppose the phosphorus and earthy matters to be generated *de novo* ; still the existence of *excessive*, or otherwise *deranged*, *nervous action*, must be admitted—and hence the nervous exhaustion, irritability and debility so commonly present and characteristic of the present class of diseases.

phates of magnesia and ammonia, from that of the phosphate of lime; but the reader is to observe that the deposition of these two salts in their separate states is comparatively a rare occurrence; and that in by far the greater number of cases, the earthy deposites consist of a mixture of the triple phosphate of magnesia and ammonia, and the phosphate of lime; the proportions of the two salts in different instances being varied in every possible grade. The further consideration of the subject falls now, therefore, to be spoken of under the head of the *mixed phosphates*.

The phenomena presented by the urinary deposite consisting of the *mixed phosphates*, vary considerably, according as the one or the other salt abounds, and according, more especially, to the source of the phosphate of lime. When the triple phosphate predominates, the deposite assumes more of the crystallised form; when the phosphate of lime predominates, and is derived from the kidney, the deposite is usually in the form of a white (or yellowish) impalpable powder; or if the phosphate of lime be derived from the coats of the bladder, the deposite usually appears partly in the form of a white powder, and partly in the form of large crystalline granules, enveloped in much tenacious mucus. As in the other form of the deposite, the phenomena presented by the urine abounding in the phosphates is liable to great variations. When the disease is constitutional, and not connected with local causes, as disease of the bladder, &c., the urine is almost always pale coloured, and, on the whole, voided in greater quantity than natural. The quantity (and of course the quality) is subject to very great and capricious changes, and sometimes, especially by day, the urine is voided in enormous quantity, amounting to actual diuresis. On such occasions the urine is pale coloured and of low specific gravity; indeed I have occasionally seen it perfectly limpid, and scarcely differing in weight from common spring water. At other times, the urine is voided in very small quantity, in which case it is deep coloured, and of a specific gravity of 1·025 or higher. When the urine is abundant and of low specific gravity, it is usually free from deposite; on being submitted to heat, however, it generally becomes turbid from a deposition of the phosphates. When voided in small quantity, on the contrary, the urine is often turbid when

passed; and in almost all instances, on standing for a time, it deposits the mixed phosphates in abundance. When the bladder is diseased, the urine is generally alkalescent from the beginning; and the earthy deposites are enveloped in large quantities of mucus, which is sometimes tinged with blood. In all instances, however, even if it be slightly acescent at first, it becomes alkalescent on cooling; hence, from its proneness to decomposition, urine depositing the phosphates is apt to become exceedingly offensive in a short time after it is passed.

A deposition of the mixed phosphates in the urine has been long observed to be accompanied by very distressing constitutional symptoms, independently of the local diseases of the bladder, &c., by which such deposition is most frequently accompanied. These symptoms vary considerably; but in general they consist of a combination of those previously described as marking the separate deposition of the two forms of the phosphatic salt. Thus there is great derangement of the chylopoietic viscera, accompanied by unusual irritability of the system in general. The derangement of the stomach is usually marked by distressing flatulence and nausea, attended, in some instances, by great acidity; the derangement of the bowels, by obstinate constipation or peculiarly debilitating diarrhoea, which frequently alternate. The dejections are usually very unnatural, being either nearly black, or what is more frequent, clay coloured, and resembling yeast. This condition of the assimilating organs is always accompanied by more or less of a sensation of uneasiness, weakness, or pain in the back and loins. There is a sallow, haggard expression of countenance; and as the disease proceeds, symptoms somewhat analogous to those of diabetes begin to appear; such as great languor and depression of spirits, coldness of the legs, anaphrodisia, and other symptoms of extreme debility; and the disease, if not speedily checked, seems capable of terminating fatally.

An excess of the mixed phosphates in the urine, considered as an idiopathic disease, is not of common occurrence; and the deposition of these salts is much more frequently accompanied by local diseases of the urinary organs. Hence a deposition of the phosphates usually accompanies protracted bladder and prostate affections; and thus superadds too frequently, the miseries of stone to the other sufferings of the patient. Even the presence

of a stone in the bladder, of whatever it may be originally composed, if permitted to remain, sooner or later produces a deposition of the phosphates; which, by incrusting the stone, adds rapidly to its bulk, and thus increases tenfold the patient's misery: as we shall more particularly point out hereafter.*

The *causes* predisposing to a deposition of the mixed phosphates are the same, in various states of combination, as those predisposing to the separate deposition of these salts. That a tendency to a deposition of these earthy salts is sometimes inherited, there can be no doubt. Moreover, this tendency often assumes different forms in different members of the same family: and even in the same individual at different periods of his life. Thus when one individual of a family has suffered from a deposition of the phosphates, another has suffered from gout, a second from asthma, a third from cutaneous disease, &c.; and several times I have seen, in the same individual, a severe asthmatic affection suddenly cease, on the appearance (generally from local exciting causes) of the phosphates in the urine. In most of these instances, a low chronic inflammatory action pervades the organs particularly affected, which often seems to partake in its character of gout and struma combined. Among acquired predispositions may be mentioned, enfeebled conditions of the nervous system, and more especially of the spinal nerves, from a variety of causes. Thus injuries of the back, by concussions, blows, or other accidents, are exceedingly liable to bring on depositions of the phosphates in the urine; particularly if other causes of a predisposing or exciting nature favour the operation of such accidents. Causes of this kind may vary indefinitely; but perhaps one of the most frequent is a fall from a horse, by which the individual has received, in connexion with a general violent concussion of the spine, some local injury of the back.† In a great

* Dr. Golding Bird states, that in ordinary conditions of the health the quantity of the phosphates in the urine is greatest in the evening (urine of digestion). On the other hand, according to my observations, the tendency to deposit the phosphates in many affections, is frequently the greatest in the morning between nine and one or two o'clock.

† It is, I believe, an old observation that certain injuries of the back are often accompanied by alkaline urine; and Sir B. Brodie informs us that he noticed the circumstance as early as 1807. I was not aware of

many instances, the immediate effects of such accidents have not appeared to be severe ; and sometimes have been even forgotten, till the patient's attention has been drawn to the subject. - Among the general exciting causes may be also mentioned severe and protracted debilitating passions, excessive fatigue, &c. Thus I have seen many instances, in which individuals have been alarmed by a deposition of the phosphates in the urine, after several days of excessive exercise and fatigue, in shooting, &c. The most frequent exciting causes, however, of such deposits, are local irritations, affecting for a considerable time the bladder or urethra : as, for instance, any foreign substance introduced into the bladder, and producing excitement of that organ, including, as we have before mentioned, all sorts of calculi in certain circumstances ; the retention of a bougie or catheter in the urethra ; strictures of the urethra in particular constitutions ; and many similar causes, are capable of producing, in all individuals, a condition of the urine readily depositing the phosphates.*

Sir B. Brodie's observation when the second edition of this work was published; but adduced the fact in explanation of the presence of the phosphates in the urine—an explanation now, I believe, generally admitted in this country. The phenomenon seems to occur in other animals as well as in man. Thus I have frequently observed jaded and worn-out horses pass great quantities of lime in their urine; the same also takes place occasionally in dogs, particularly of the sporting kinds ; and in both these instances, I have thought it probable that the circumstance was connected with some strain or injury of the back, produced by over-exertion, or other causes.

* I cannot admit the explanation of the deposition of the phosphate under such circumstances to be generally true ; namely, that *the urine in contact with the foreign substance always undergoes an incipient process of decomposition*. If this were really the case, all sorts of calculi might be supposed to act as foreign substances, and ought to be immediately covered with the phosphates—a circumstance in direct opposition to experience. The fact is, that the foreign substance, before it can be covered with the phosphates, sympathetically affects the system, and causes the urine to become alkalescent, or to abound in these salts. Mr. Forbes has some observations on this point, which, as they exactly coincide with my views, by substituting "phosphates" for "concreting acid," I shall quote. " In proper or healthy urine, there is not in clean vessels a particle of the phosphates deposited, the whole of these being in perfect solution ;" and " to the end of time, there would not be calculus from renewed applications of urine in which the phosphates do not predominate." " When a foreign body gets into the bladder, if it meets not

Subspecies b.—*Of the diseases connected with the soluble incidental matters, including soda, potash, and ammonia.* I am not aware that diseases characterised by derangements of the soluble incidental alkaline matters have been separately noticed by authors—a circumstance probably referable to their close connexion and usual co-existence with a deposition of the earthy phosphates. That there are, however, several distinct forms of disease connected with derangements of the soluble alkalies in the urine, independently of the phosphates, I have long observed; I shall therefore briefly notice them; though, in a practical point of view, their treatment, perhaps, differs but little from the treatment appropriate to a deposition of the phosphates.

The *urine* in most of these diseases is alkaline when passed. Its smell is ammoniacal, modified by an odour strongly urinous and offensive; sometimes peculiar. It is usually pale coloured, but occasionally assumes a reddish tint, like that of the washings of flesh; and from the mucus or pus always present, it is more or less opaque. The earthy phosphates are rarely entirely absent, but their quantity seems to be below the standard quantity of health; while the quantity of soda (potash?) and ammonia appears to be in excess; or strictly speaking, the carbonates of these alkalies appear to be in excess; hence such urine generally effervesces strongly on the addition of an acid. The quantity of urea present is usually deficient; but what is remarkable, in some of the varieties of this form of alkaline urine, the secretion contains a large proportion of the lithate of ammonia and soda, which, being deposited as the urine cools, adds to its opalescence. The specific gravity of these specimens of alkaline urine is subject to considerable variety. In some instances the

with the phosphates already redundant, it would operate by irritation so as to occasion redundancy.” Hence, “if a piece of bougie were to get into the bladder of a person the state of whose urine is perfectly natural, it must operate to the production of different qualities in that fluid before it can be incrusted. When the misfortune has occurred, the urine has been before in a state too much adapted to incrustation. The diseases which require catheters and bougies are almost uniformly accompanied by prevalence of the phosphates, from the general and particular sympathies by which they are attended.” Treatise upon Gravel and upon Gout, in which their sources and connexions are ascertained, &c., page 74. By Murray Forbes, Esq.

specific gravity is below the standard of health; while in those instances, more especially, in which the alkaline lithates abound, the specific gravity is usually higher than natural. The quantity voided also is subject to much variety. Occasionally the quantity exceeds that of health; but in those instances in which the specific gravity is higher than natural, the quantity is usually limited; notwithstanding the very frequent calls upon the patient to void it from the bladder.

The *constitutional symptoms* accompanying the various forms of urinary disorder now under consideration, partake of the characters of those accompanying the deposition of the phosphates. They are subject, however, to considerable modifications, in general marked by their severity. Indeed, some of the varieties may be viewed as constituting the last stages of the phosphatic diathesis, when accompanied by the aggravated misery arising from organic disease, and stone in the bladder; under which heads, therefore, they fall more properly to be considered.

The *causes*, both *predisposing* and *exciting*, are analogous to, if not identical with, those producing a deposition of the phosphates. Indeed the most frequent forms of the affection usually take place, when the general health has become seriously affected by the long continuation of the phosphatic disease; particularly if aggravated, as is usually the case, by injury of the spine, or by a stone in the bladder. Under these circumstances, the mucous coat of the bladder becomes disorganized, and its natural functions impaired or destroyed; hence, instead of mucus charged with the phosphate of lime, the diseased surface of the bladder throws out large quantities of the serum of the blood, more or less altered; and the alkaline matters naturally incidental to this serum give occasion to the phenomena in question. Cases of this description constitute the varieties of the disease usually distinguished by urine of low specific gravity; and in such cases it is probable that the disorganizing processes are not confined to the coats of the bladder, but extend to those of the kidneys. On the other hand, in those instances in which the urine is of high specific gravity, and is loaded with the lithate of ammonia, the disease appears to be chiefly confined to the bladder. I say *appears*, for I have had no opportunity of verifying the remark;

and confess myself unable to explain the causes of the differences assumed by the urine in these two modifications of the disease, which often appear to merge into each other; and to be most frequently connected with the same cause, viz., spinal derangement. It may be further remarked, that in several of the instances in which the urine was of high specific gravity, and loaded with the lithates, the patients were, or had been, subject to gout.

Having detailed the usual phenomena, constitutional symptoms, and causes of the two varieties of disease connected with the insoluble and the soluble incidental matters of organized products; we come now to speak of the *General diagnosis, prognosis, and treatment* of the whole in conjunction.

On the *General diagnosis*, of these affections we need not dwell; as the chemical properties of the sedimentary matters at once afford the means of distinguishing them one from the other. Those, therefore, who are acquainted with the chemical properties of the deposits, will find no difficulty in recognising the different states of disease with which they are associated.

The *General prognosis* in these affections varies considerably in the different forms of the disease, as well as in the same disease, according to the nature of their cause, and the degree of their severity. Taken as a whole, however, the prognosis in these diseases may be said to be of an unfavourable character, on account of their deep-seated and constitutional nature. The prognosis in the deposition of the triple phosphate, provided it be of a temporary nature and dependent on a cause that can be mitigated or removed, is not very unfavourable: but if the deposition be constant, and the cause be of such a nature as not to admit of mitigation or removal, the prognosis is very unfavourable. So in the occasional deposition of the phosphate of lime from gout, the prognosis is much less unfavourable, than when the deposition is constant and depends on disorganization of the mucous membrane of the bladder, &c. Nearly the same observations apply to the deposition of the mixed phosphates. If the nervous system be deeply involved from injury of the spine or from other cause; if the prostate has become enlarged and irritable, and the mucous surface of the bladder, &c., diseased, the deposition of

the phosphates can hardly be prevented by any known means; and the chance, moreover, will be, that the patient will suffer from the formation of a stone in the bladder in addition to his other complaints; and finally sink under this complication of miseries. The prognosis in those cases in which the soluble incidental matters are chiefly concerned, is, on the whole, perhaps, even more unfavourable than those in which the phosphates are deposited. The danger is least in those forms of the disease of occasional occurrence, or which are connected with gout; but in those severe forms which occasionally follow injuries of the spine; or as the sequelæ of the phosphatic deposition, and which, for the most part, denote irremediable organic disease, there is scarcely a chance of recovery.

In speaking of the *General treatment* of these affections, we shall first consider the subject of diet and regimen.

From the alkalescent, and more especially from the ammoniacal condition of the urine in these affections, a diet as free as possible from azote, and of a vegetable and accescent nature, has been insisted on, by some writers, in these diseases. The reasoning, however, on which this plan of diet has been recommended, is, perhaps, too exclusively chemical; and has been made without reference to those important, constitutional symptoms which we have stated to accompany the affection. We have seen, that generally speaking the vital powers are in an asthenic condition during the deposition of the phosphates. So far, therefore, from an innutritious vegetable diet being appropriate, a diet precisely the reverse appears to be indicated; that is to say, a diet consisting of a due proportion of easily assimilated and nutritious animal matters. Experience accords with this view of the case; and I have also found that when the constitution is deeply involved, as is usually the case, in an habitual deposition of the phosphates, a generous animal diet agrees by far the best with the patient; and is indeed necessary to his well-being. The diet also should consist principally of solids; and fluid aliments, such as soups, &c., should be sparingly employed. If the patient has been accustomed to wine, some of the more generous of the Rhine, Moselle, or Bucellas wines will be found preferable; at least in this climate. In warm weather, and in warm climates, the lighter French wines, as the Chablis, &c., have been particu-

larly recommended, and in many instances they appear to exert a beneficial action ; as do sound cider and perry ; indeed fluids containing the malic acid seem to possess peculiar powers in arresting the deposition of the phosphates in some individuals.

The same principles should be kept in view with regard to exercise and general regimen. Whatever fatigues or exhausts, either bodily or mentally, will do mischief. Hence absence from care, the exhilarating air of the country, and such occupations as are consistent with the patient's peculiar condition, will perhaps, more than anything else, contribute to the cure ; particularly in those slighter and induced cases, in which the affection is not complicated with local injury. The observations on diet and regimen here given are to be understood in a general sense as applicable to the whole class of the affections under consideration ; and it scarcely need be added, that the details must be varied so as to suit particular cases, according to the judgment of the practitioner.

From the peculiarly nervous state of the system which commonly attends a marked deposition of the triple phosphate, the use of some *sedative* is generally indicated as a constituent element of the means of treatment. The same state of nervous irritation is usually accompanied by, or is the result of, debility ; hence another class of remedies usually indicated is *tonics* of various kinds ; lastly, the alkaline or alkalescent condition of the urine requires to be corrected, as far as we are able, by *acids*. Sedatives, tonics, and antalkaline remedies, therefore, of various kinds, and variously associated, according to the particular symptoms and circumstances of the case, constitute the most efficient means we possess of combating that peculiar condition of the system accompanied by a deposition of the triple phosphate in the urine ; and in general the slighter cases will readily yield to the due administration of these remedies ; while the severer and more deep-seated cases will commonly become ameliorated under such a plan of treatment. Of particular sedatives, those which seem best adapted to the milder forms of the disease, are henbane and camphor, either separate or combined, according to circumstances : while in the severer forms of the affection the various preparations of opium are necessary, of which, perhaps, the best suited to this particular form of disease is the *liquor opii seda-*

tivus of Battley. These or other sedatives may be associated with different tonic infusions; or with the decoction of the *Parreira brava*, or of the *Lythrum salicaria*, the infusion of the *alchemilla arvensis*, the acidulated infusion of roses with quinine, iron, &c., according to the judgment of the practitioner. If there be a sense of uneasiness or pain in the back, as is usually the case, various plasters or liniments may be resorted to; such as the opium or belladonna plasters; the *Linimentum camphoræ comp.* &c. Lastly, with a view of corroborating the system generally, the shower-bath, tepid or cold, and particularly the tepid sea shower-bath, will be often found serviceable.

Of the remedies best suited to a deposition of the phosphate of lime, considered as a separate disease, I can say but little. The affection is so rare, that in the last twenty years I have not seen half a dozen well-marked instances. Of these, as I have stated, the greater portion has been distinctly associated with the gouty diathesis; and have not only occurred either during, or subsequently to, an attack of that disorder; but the deposition of the phosphates has subsided as the gout has disappeared. With the history of the remaining cases I am unacquainted. What little, therefore, is to be said on this subject, will be more appropriately given under the head of the mixed phosphates.

A decided deposition of the mixed phosphates, whether viewed as an idiopathic affection, or as associated with disorganization of the bladder, &c., is a very formidable state of disease. As, however, the two conditions of the affection just stated differ somewhat both in their pathology and treatment, we shall consider their treatment separately.

The general indications of treatment in an idiopathic deposition of the mixed phosphates, resemble in all respects the indications of treatment of the triple phosphate, before mentioned; but differ considerably in degree. That is, the use of sedatives, tonics, and acids, is more or less indicated. In severe idiopathic cases of the mixed phosphates, the only remedy of the class of sedatives that can be relied on, is opium in some one or other of its forms. This remedy it will be often necessary to administer freely, at short intervals; as, for instance, in doses of from one grain to five grains twice or thrice a day. Under the use of this remedy, the more distressing symptoms will be commonly relieved; and when such

relief has been obtained, the dose of opium may be gradually diminished, and the use of tonic and antalkaline remedies introduced; such as the different preparations of iron, or of bark, with the mineral acids, &c. Sedative plasters also, as formerly mentioned, may be applied to the loins; or if the symptoms be unusually severe, or connected with permanent local injury, setons or issues may be applied to the neighbourhood of the parts immediately affected. The state of the bowels, as we have noticed, is very irregular and difficult of management, during a deposition of the mixed phosphates. Most frequently they are constipated, but purgatives, especially of the more active class, must be administered with caution. I have seen, for instance, the most serious consequences brought on by a small dose of calomel, which, by inducing diarrhoea and consequent debility, has much aggravated all the symptoms, and even endangered the life of the patient. Saline purgatives also, more especially those containing a vegetable acid, as the Rochelle salts, the Seidlitz powders, and even the common effervescent saline draught, are to be carefully avoided; and recourse must be had to small doses of castor oil, or to laxative injections. The compounds of ammonia, on the other hand, with the vegetable acids, as the acetate, citrate, benzoate, &c., of ammonia, often exert a most beneficial action in these affections; and Mr. Ure has lately particularly recommended the benzoic acid in its uncombined state in depositions of the phosphates. Mercury in all its forms, particularly when pushed so far as to produce its specific action on the constitution, seems capable of doing a great deal of mischief; more especially in the severer forms of the affection: and if from other causes it be judged necessary or proper to administer this remedy, it must be managed with great care, and its effects closely watched. Perhaps the best mode of exhibiting mercury in such cases is to combine it with opium, or, in some instances, with a purgative. In the severe forms of the disease, however, now under consideration, the use of mercury, if possible, had better be omitted altogether till the more distressing symptoms have somewhat yielded, and the patient has recovered a little strength. Nearly the same remarks apply to alkaline remedies in general, and indeed to all remedies calculated to increase that tendency to periodical diuresis which frequently constitutes a striking feature in the disease. Among

such diuretic articles may be mentioned *hard* waters, the influence of which, in every point of view, is generally most unfavourable.

In less severe cases, when the source of irritation, or cause of the disease, is temporary or local, that is, when it depends on the abuse of mercury or any other reducing cause, or on local affections of the urinary organs; in short, in all cases in which the disease has been induced rather than original, and in which, consequently, the general health and strength have been but little impaired, means similar to the above may be resorted to, though they seldom require to be carried to the same extent; thus if opiates are necessary, the milder preparations of this drug, as the aqueous extract; or the compound tincture of camphor, either alone or associated with henbane, conium, &c., will be commonly found to be more appropriate than the powerful preparations, *morpbia*, &c.; or even than crude opium. Moreover, when the cause depends on local irritation about the bladder, of a temporary character, and the constitution has not yet become involved, leeches or purgatives, or both, may often advantageously precede or accompany the use of sedatives; and the sedatives, instead of being associated with tonics, &c., as in severe cases, may be much more beneficially combined with the citrate or acetate of ammonia. This arises from the inflammatory character of many local affections in their early stages; which inflammatory action, if it be injudiciously treated with tonics and astringents, and not promptly met at the outset, often gives occasion to aggravated forms of disease, too frequently incurable by any means whatever. In temporary depositions of the phosphates connected with a gouty diathesis, acidity of the stomach is often a troublesome symptom; and in such cases much relief is obtained by the use of small doses of the carbonate of soda, combined with bitter infusions. So, again, the temporary deposition of the phosphates in the urine of children generally depends on the derangement of the bowels, &c., and readily yields to the judicious use of purgatives, (of which calomel, in many instances, may form an ingredient,) without the aid of sedatives.

In the severer forms of local disease of the urinary organs, accompanied by a deposition of the mixed phosphates, and associated, as they too frequently are, with stone in the bladder,

the principles of treatment will, in general, be the same as those above mentioned. In such instances, however, the local symptoms are of so prominent a character as to constitute specific diseases, requiring, in addition to the general means above alluded to, specific or peculiar treatment. The consideration, therefore, of the deposition of the phosphates, under these forms, will be deferred till a future chapter, expressly devoted to the subject.

The deposition of the triple phosphate in excess, is so common, that every one who has paid attention to urinary diseases must have noticed it; I do not think it necessary, therefore, to illustrate the affection by reciting cases. The deposition of the phosphate of lime in excess, is much more rare; and though I have seen several well-marked instances of this affection, I am unable to give a detailed history of any one case. The deposition of the mixed phosphates is common enough in connexion with disease of the bladder and calculus; but is much more unusual as an idiopathic affection. I shall, therefore, reprint the following cases, illustrative of such idiopathic deposition of the phosphates, as I have nothing more striking to offer on the subject.

CASE I.—August 14th, 1820.—J. E., aged 42, joiner, has been a sailor; and nineteen years ago, when on board a ship, got a fall upon his back, which particularly affected the left side, about the region of the loins. This fall confined him three months on crutches; but he afterwards, as he supposed, got completely well; though every spring or summer since that period, he has always suffered in some degree, and for a greater or less time, from pain in his loins. The present attack commenced eighteen months ago, in the usual manner, but with greater severity, and has continued more or less ever since. Till within these four months, however, he had not been led to observe anything peculiar in his urine; but had been only annoyed with the usual painful symptoms and weakness in the back. At this time, the quantity of water began to increase very much, and he observed it to deposit occasionally a very large sediment of earthy matter. Under these circumstances, he went to a dispensary, where his disease appears to have been considered as diabetes, and treated accordingly; but without any advantage. His symptoms at present are severe enervating pains in the regions of the loins, extending round to the groin and

lower part of the abdomen, and occasionally down the thighs and legs, accompanied by retraction and soreness of the testes. Occasionally, also, he suffers excruciating pains in the head, affecting his sight. All these symptoms, however, are much worse on certain days than others, and the worse symptoms are usually accompanied by diarrhoea. Latterly he has become much thinner than usual ; his appetite has fallen off ; he sweats on the least exertion ; and among other symptoms of debility has complete anaphrodisia. He is thirsty ; his tongue is clean, and rather redder than usual ; he is troubled with flatulence, and his bowels are very irregular. The state of his urine, also, is very variable. What he passes first in the morning, and perhaps once more in some other part of the day, is at first commonly transparent, and of a light yellow colour ; but soon deposits a sort of mucous cloud, which in a few hours becomes converted into a perfectly white earthy matter. The specimen of the urine of this description which he brought with him, was contained in a two-ounce phial. Its specific gravity was 1·0234 ; and the earthy matter, after it had been allowed to stand some time, occupied nearly one-third of the height of the bottle. The earthy matter was in the form of a fine white powder, and was found to consist of the mixed phosphates. This urine, when first voided, reddened litmus paper ; and contained a large proportion of urea, and fully the usual quantity of pale-coloured lithic acid. At other periods of the day, and particularly during the morning, he is conscious of a sense of tightness or fulness of the abdomen ; from which he is relieved by a fit of diuresis, during which he voids large quantities of a limpid colourless urine, nearly free from all sediment. I had likewise an opportunity of examining a specimen of this urine, and found its properties exactly resembling the other ; except that it was much more watery, and its specific gravity was only 1·0064. The urine had a disagreeable smell, and was very prone to putrefaction ; in which state the smell emitted was peculiarly offensive. It may be also observed, that the urine was passed without difficulty or urgent desire, except what arose from its quantity ; which he supposed amounted, in twenty-four hours, to four or five quarts. Ordered *pil. saponis c. opio gr. v. bis die.*

August 22.—Found instant relief after taking the pills ; urine reduced to three quarts in twenty-four hours. States that the

white sediment has nearly disappeared ; complains of being very costive. On examining the urine voided yesterday morning, its specific gravity was found to be 1·0137 ; and there was a slight deposite of the earthy phosphates ; but its properties in other respects were nearly as before. The urine voided this day, at six in the evening, was almost perfectly colourless and transparent, and had a specific gravity of only 1·0027. *Contr. pil. saponis c. opio gr. v. ter die. Sumat cras mane olei ricini 3j.*

23rd.—The castor oil affected the bowels moderately, and afforded him some relief. Continues tolerably free from pain. The urine voided in my presence at six o'clock in the evening did not differ in appearance and spccific gravity from common spring water ; though it still emitted in a less degree the same offensive smell as formerly.

29th.—Felt better for three days after I last saw him ; the urine diminished in quantity, and the white deposite entirely disappeared. For the last threc days the pain has returned, and the urine has increased in quantity. What was passed this morning had a specific gravity of 1·0242, and deposited a very copious mucous cloud, but no earthy sediment. The quantity of urea was excessive. *Pil. saponis c. opio gr. x. ter die.*

Scptember 2nd.—Feels a great deal better. Little or no pain for the last three days. The urinc deposits no white sediment, and he passes only a little of the elcar urine in the afternoon, the whole amounting in twenty-four hours to two quarts. The specific gravity of what was passed this morning was 1·020, and it contained an excess of urea. He has been costive for the last two days. *Pil. saponis cum opio gr. x. ter die. Ol. Ricini 3j. cras mane.*

12th.—Almost quite free from pain, and tried in consequence to resume his work ; but was obliged to desist, on occount of a distressing sense of weakness in the back. His appetite is much improved, he sweats less than usual, and is not sleepy. Rather costive. Urine reduced to two quarts in twenty-four hours : specific gravity of that voided in the morning 1·0174. *Pil. saponis c. opio gr. x. mane meridieque ; et gr. xv. hora somni. Olei Ricini 3j. cras mane. Emplast. picis comp. lumbis.*

13th.—Took the castor oil, which induced a diarrhœa that lasted for two or three days, during which time his pain returned.

It was less severe, however, than usual, and was accompanied by a peculiar sense of coldness and weakness in the calves of his legs. Has now recovered from the diarrhoea, and all the other symptoms, and has not felt so well for many months. Urine in twenty-four hours about two quarts, and quite free from earthy sediment. Specific gravity of that voided this morning, 1,0207. *Pil. saponis c. opio gr. x. ter die.*

November 30th.—I saw this poor man again, and was happy to hear that he had continued quite well from the last date, and had followed his work as usual, having taken the pills occasionally. He had recovered his ordinary strength, &c., and his urine now abounded in the lithate of ammonia.

In September, 1822, nearly two years after the last date, I learned that this patient had remained quite free from his complaint ; and was then so well in all respects as to be able to follow his work as usual. Since that period I have not heard of him.

The only case on record that I am at present acquainted with, equal to the above in severity, is one summarily described by the late Dr. Henry, as follows : *

CASE 2.—“ Several years ago, the Rev. Mr. R_____, of Cheadle, in Staffordshire, consulted me respecting a train of very distressing symptoms, some of which evidently denoted considerable disease in the kidneys. His urine, which sometimes was perfectly limpid, was at others loaded with a white substance, which gave it, when first voided, the opacity of milk. On standing, a copious deposite took place, a portion of which was sent me for examination. It was perfectly white, and so impalpable as to resemble a chemical precipitate. On analysis it proved to be composed of nearly equal parts of the triple phosphate and phosphate of lime. The discharge of this powder was always pre-

* Med. Chirurg. Trans. x. p. 139. There are also two cases somewhat similar in Dr. Rollo's Treatise on Diabetes, p. 424, second edition. Both these cases were produced by injuries of the back, and were considered to be of a *diabetic* nature. The deposition of the phosphates is not indeed mentioned ; but as this is a symptom not constantly present in these affections, the circumstance might have been overlooked ; particularly as the attention was otherwise directed. In these cases, Diuresis was the remarkable symptom. See page 107, where similar instances are alluded to.

ceded by violent attacks of sickness and vomiting ; and its quantity was invariably increased whenever he took soda water, or any other alkaline medicines. Besides the affection of the kidneys, there appeared to me to exist important disease of the erythropoietic viscera ; and to this I ascribe his death, which took place a few months afterwards. In this case it was remarkable that the weight of the body was reduced from one hundred and eighty-three pounds to one hundred pounds, at rather an early state of the disease ; without a corresponding degree of muscular emaciation."

No one can doubt, I think, that this case resembles the preceding, differing only in degree ; and it is to be regretted that we know so little about it—particularly its cause.

CASE 3.—The following case I relate principally with the view of illustrating an opinion I have advanced, that the deposition of the phosphates is, in some instances, rather to be considered as indicating an increased secretion of earthly matter, than of the phosphoric acid. The patient was a gentleman between thirty and forty years of age, who had for several years laboured under stricture of the urethra, (acquired, I believe, in the usual manner,) for which he had consulted an eminent surgeon, and obtained much relief. He never considered it, however, as entirely removed ; and was in the habit of occasionally introducing a bougie himself. Latterly, the irritation had become greater than usual, especially at the moment of voiding the last portions of urine, and for some time afterwards ; and he now observed, that he passed at this time a very considerable portion of white earthly matter mixed with mucus. At length he voided one or two small calculi composed of the same earthly matter, which gave him alarm, and induced him to apply for medical advice. His countenance was sallow and unhealthy, and the functions of the digestive organs evidently deranged. The earthly matter, and particularly the small calculi, consisted almost entirely of the *carbonate of lime*, mixed with a small proportion of the earthly phosphates. He was ordered an alterative pill composed of the *pil. hydrarg.* and extract of gentian, and to take the muriatic acid thrice a day. The acid disagreed so much with him, that he was obliged to leave it off immediately. Nothing else was ordered ; but he took a little respite from the fatigues of business, and went into the country ; from whence

he returned in the course of a few weeks, perfectly well ; and has had no return of the affection since. It may be also remarked, that the symptoms of irritation in the urethra, ascribed to the stricture, subsided with the disappearance of the earthy matter.

In this case the secretion of lime without phosphoric acid is remarkable. That the origin of this carbonate of lime was from the irritated surface of the bladder or urethra, there can be no doubt ; but why the lime should in this instance be secreted without the phosphoric acid, as is usual, hardly admits of explanation, except on the supposition previously advanced—that the two ingredients are connected with different tissues and different diseases. It may be remarked, that the phosphate of lime secreted from diseased mucous membranes is almost always mixed with a little carbonate of lime.*

Lastly, I wish the reader to distinctly bear in mind that the urinary organs are not the only parts of the body through which the incidental matters of organization are separated from the system. Immense quantities of the phosphates, and particularly of the triple phosphate of magnesia and ammonia, are sometimes discharged from the intestines ; from the salivary glands ; and from other outlets of the body ; as well as from the kidneys. The same is true also of the phosphate and carbonate of lime, which are deposited in, and discharged from, a variety of localities. In such, and indeed in all cases, the circumstances that determine the separation of these earthy matters are probably of a local nature, and partake of the characters of what, for want of a better term, we must denominate chronic inflammation, or rather chronic degeneration. The observations and principles of treatment mentioned in the preceding pages as applicable to the discharge of these earthy matters from the urine, are probably equally applicable to

* See note, page 284. Of the remarks stated in the note referred to, viz. that lime and phosphoric acid (phosphorus) are derived from different sources, or rather are the results of different diseased actions, the present case constitutes a striking example. The carbonate of lime could scarcely have been derived in this instance from any other source than the mal-assimilation or destruction of the peculiar tissue of which lime forms the characteristic incidental element.

the deposition of them in other organs : though it must be confessed that this part of the subject has not been so carefully studied as it deserves to be. When the earthy matters are discharged from the bowels, as they most usually are, they are rarely seen ; and hence, probably, the reason why this mode of their exit has been so long overlooked. Sometimes the quantity of the earthy phosphates is so large, particularly in children, as to attract notice ; while in adults they occasionally form intestinal concretions ; of which numerous instances are recorded.

Dr. Bence Jones has lately published a valuable series of nine papers on the variations in the *quantity* (not the *deposition*) of the phosphates in the urine in different diseases ; and the following are his conclusions :—

“ Paper i. The variations of the earthy phosphates, are so dependent on the earthy matters present, that no deduction from them of the nature or state of the disease is possible.

“ Paper ii. Neither the earthy phosphates nor the alkaline phosphates are increased in spinal diseases.

“ Paper iii. In fevers and acute inflammations of fibrous, muscular, or cartilaginous tissues, the amount of earthy and alkaline phosphates together is not increased.

“ Paper iv. In chronic diseases in which the nervous tissue is not affected, no deduction can be made.

“ Paper v. Chronic cases of general paralysis, mania, and melancholia, give no marked results.

“ Paper vi. In chronic diseases of the brain, and in chronic or even acute disease of the membranes, there is no increase of earthy and alkaline phosphates together.

“ Paper vii. In fractures of bones of the skull, when any inflammation of the brain appears, there is an increase of the phosphates. When there are no head symptoms, no increase of the phosphates is observed, even when other acute inflammation super-

"Paper viii. In acute inflammation of the brain there is an excessive amount of phosphates excreted. When the acute inflammation becomes chronic, no excess of phosphates is observed.

"Paper ix. In some functional diseases of the brain an excessive amount of the phosphates is observable. This ceases with the delirium. *Delirium tremens* shews a most striking deficiency in the amount of phosphates excreted when no food is taken. When food can be taken the diminution is not apparent.

"Hence the general deductions are—

"1st. That acute affections of the nervous substance, organic and functional, are the only diseases in which an excess of the earthy and alkaline phosphates appear in the urine.

"2ndly. That the amount of phosphates is sometimes excessively diminished in *delirium tremens*.

"3rd. That no chronic diseases shew any marked excess in the total quantity of phosphatic salts excreted—that is, so far as the mode of analysis employed, is conclusive. *Mollities ossium* in its most active form is an exception to this deduction.

"It seems then probable that the action of oxygen on the nervous substance is lessened by alcohol; and that by acute inflammation, or excessive excitement of the brain, it is pre-eminently increased."

"When I began" says Dr. B. Jones, "the examination of the variation of the phosphates, I hoped thereby to trace the action of oxygen in the system. I thought at first only of determining the amount of earthy phosphates. Finding this would give no result—for their amount almost always depends only on the quantity of lime or magnesia passing out of the system,—I went on to determine the highest amount of earthy and alkaline phosphates together. I expected to find an increased production of phosphates in all head cases, whether chronic or acute. There I looked for the greatest action of oxygen on phosphorus—that is for the highest formation of phosphoric acid in disease." The results of his experiments however proved to be somewhat different from his expectations; and shew, as we have seen, that a *decided increase* of the phosphates takes place only in *acute diseases* of the nervous structures.

The quantity of sulphur and phosphorus which, in certain diseases, escapes by the kidneys imperfectly, or entirely unacidulated, is sometimes considerable. This we have elsewhere alluded to ; and we may here remark, that our conclusions were drawn from observations made many years ago. An extensive inquiry in this direction would form a most valuable supplement to Dr. B. Jones's papers.*

* This subject has been lately taken up by Dr. Ronalds, who finds that from three to five grains (one fourth of the whole quantity of sulphur excreted by the kidneys) passes off daily by the urine, in some other state than that of sulphuric acid. Dr. R. is understood to be pursuing the inquiry with regard to phosphorus. See Philos. Trans. 1846.

BOOK II.

OF MECHANICAL DISEASES.

COMPREHENDING THE DESCRIPTION AND TREATMENT OF DISEASES ARISING FROM OBVIOUS LESIONS OF THE KIDNEY AND BLADDER; AND PARTICULARLY FROM THE PRESENCE OF CONCRETIONS IN THESE ORGANS.

WE come now to consider the important class of diseases arising from visible organic lesions of the urinary organs; and particularly from the presence of mechanical irritants in the kidney and bladder. These diseases vary exceedingly in their nature and symptoms; and many of them fall exclusively within the province of the surgeon. The most important of these diseases may be classed under the following heads:

CHAP. I. Of the origin and increase of calculi in the kidneys; comprising a sketch of the symptoms produced by the presence of such foreign bodies in the kidney and ureter; and of the appropriate medical treatment.

CHAP. II. Of disease of the kidneys, produced by, and liable to be confounded or associated with, calculus in these organs; and of the treatment of such diseases.

CHAP. III. Of the origin and increase of calculi in the bladder; and of the symptoms and treatment of vesical calculi in general.

- CHAP. IV.** Of diseases of the bladder and its appendages, produced by, and liable to be confounded or complicated with vesical calculi.
- CHAP. V.** Of haemorrhage from the urinary organs in general.
- CHAP. VI.** Of incontinence and retention of urine.
- CHAP. VII.** Observations on the removal of calculi from the bladder ; comprising remarks on the effects of solvents for the stone ; and on the operations of lithotomy and lithotripsy : with a review of the circumstances which ought to determine the choice of one of these means in preference to the other ; or which render all of them inapplicable or dangerous.

CHAPTER I.

OF THE ORIGIN AND INCREASE OF CALCULOUS DÉPOSITES IN THE KIDNEYS; COMPRISING A SKETCH OF THE SYMPTOMS PRODUCED BY THE PRESENCE OF SUCH FOREIGN BODIES IN THE KIDNEY AND URETER; AND OF THE APPROPRIATE MEDICAL TREATMENT.

THE subjects of this chapter are naturally divided into two sections—

SECTION *a.* *Of the origin and increase of renal concretions;* and, SECTION *b.* *Of the symptoms and treatment of renal concretions.*

SECTION *a.—Of the Origin and Increase of Renal Concretions.*

The chemical properties of the substances of which the different varieties of urinary calculi are composed, materially influence their mode of formation in the kidney; we shall, therefore, briefly consider the formation of each variety of concretion separately; and as the lithic acid is by far the most frequent variety of renal calculus; and its formation in the kidney best illustrates the principles on which renal calculi in general appear to be produced; instead of the oxalate of lime, which, according to our arrangement, should have the precedence, we shall commence with the lithic acid calculus.

1. *Of the Origin of Lithic Acid Renal Concretions.*—For an account of the condition of the urine and the constitutional

symptoms attending the lithic acid deposite, the reader is referred to a former chapter.* Taking for granted, therefore, that the subject is so far understood, we shall resume the history where we then left off; and proceed at once to describe the symptoms usually attendant on the formation of a lithic acid calculus.

The urine of those individuals who have a tendency to form lithic acid concretions, continues almost constantly, for a great length of time, to deposit lithic acid in some shape or other. This, being accompanied by no very remarkable or severe symptoms, often escapes their observation; they proceed, therefore, in their usual habits, while the disease insidiously continues to gain ground daily. At length, about the age of forty, the affection begins to assume its most aggravated form; and both crystallized and amorphous sediments appear in the urine; occasionally in enormous quantities. At the same time, a peculiar state of the system, accompanied by fever, and closely resembling the condition of the system in gout, to which it is generally referred, comes on. The urine is now very much diminished in quantity, (often amounting almost to suppression,) its specific gravity unusually great; its colour very deep; the sediments unusually large, (or occasionally they disappear altogether;) and under these circumstances lithic acid is separated by the kidney in the state of a semi-fluid hydrate; which becoming solid, gives occasion to renal calculus. During the above state, there is commonly a sense of dull pain, or weight in the region of the kidney, and just above the pubes; but as these symptoms are not very severe, they are little attended to; and after a few days, the whole gradually subside, or perhaps terminate in an attack of gout. Sooner or later after the above symptoms, but commonly not before they have subsided, and the urine has begun to be secreted in its usual quantity, the patient is seized at once, and perhaps without the least warning, with a most acute pain in the region of the kidney, accompanied by violent sickness and vomiting; and with other symptoms to be presently described, when we come to treat of the mechanical effects of urinary concretions.

Such is the history of the formation of a lithic acid calculus

* See page 194.

in the kidney, as I am convinced I have seen it. Of course I cannot positively assert that the nucleus is generated during the existence of the symptoms above described; but I have met with such strong evidence of it, that no doubt on the subject has been left in my mind. I do not see also how it is possible to account for the sudden nephritic attacks which frequently take place, during perfect health; except on the supposition that the calculus had been formed before, and had lain for some time in the kidney; which it very frequently appears to do, without producing much pain or even uneasiness. I admit that it is extremely difficult to get at the truth, on these points; the attention of patients being generally too much taken up with their present sufferings to attend to what took place some time before; and particularly to what was slight, perhaps, and in their estimation little connected with their present suffering. Besides, the calculus might have been formed months or years before, and thus the symptoms attending its formation have altogether escaped from their memory.

In the preceding narrative of the circumstances attending the formation of a lithic acid calculus in the kidney, we alluded to the hydrated form which this acid is capable of assuming, and the part this property plays in the formation of the calculus. We have now to illustrate this, and the collateral circumstances, a little more in detail.

That renal calculi of lithic acid are most likely to be formed when the lithic acid abounds in the urine, is sufficiently obvious; yet when we consider how common such a condition of the urine is, compared with the infrequency of renal calculi, it is equally obvious, that the mere presence of lithic acid in the urine cannot be the *only* cause. The fact is, that though the above conditions of the urine and of the health strongly predispose, and are even necessary, to the deposition of calculous nuclei; the presence of other circumstances are likewise required for their immediate formation. Some of these circumstances may be occasional, and purely accidental; but generally they are the result of disease, and somewhat analogous to the following:

We have shown that the lithic acid is capable of existing in a semi-fluid state, or as a *hydrate*, for some time before it under-

goes the process of crystallization. This may be illustrated by dissolving a little lithic acid in an alkaline solution, and precipitating it, when cold, by the addition of muriatic acid. The lithic acid is separated in the form of a bulky gelatinous mass ; which after a while begins to diminish rapidly in size, and at the same time, to assume the crystallized form. Now the lithic acid and the lithate of ammonia may be often seen deposited in great abundance in human urine, in this hydrated and gelatinous form, before they assume the crystallized and pulverulent conditions. The lithate of ammonia, also, voided by birds, serpents, &c., and the lithate of soda formed in the human subject during gout, when first secreted, exist in this semi-fluid or plastic state ; and afterwards become hard, on undergoing an imperfect kind of crystallization ; by which they are separated from the water with which they are combined and held in imperfect solution.

The kidney is made up of a congeries of smaller parts, or of little kidneys, if we may use the expression ; each one of which is independent of the others in its structure, and may, therefore, probably independently of the others, become deranged in its functions. Let us suppose one or more of these little kidneys similarly deranged to the others, but in a greater degree ; so as to secrete very little water, but a large proportion of lithic acid. In such a case, the lithic acid must be obviously separated in the peculiar hydrated condition above mentioned. In this state it is bulky, and a small portion may thus occupy the whole of the infundibulum in which it has been deposited ; or the quantity may be supposed to be so great, as to be partly protruded into the common receptacle or pelvis of the kidney. After remaining in these positions for some time, crystallization may be supposed to take place ; the semi-fluid mass will now be much diminished in bulk, and perhaps reduced to the form of a mass of crystals easily separable from each other ; and thus pass off in the form of red gravel. Or what may be easily imagined to take place, especially when the lithic acid is very impure and combined with a larger portion than usual of other matters ; the gelatinous mass of hydrated lithic acid may assume the form of an imperfectly crystallized or amorphous solid mass ; and thus constitute a nucleus for a future calculus pos-

sessing these characters. Or something between these two extremes may take place ; the plastic mass of lithic acid may partly separate into crystals, and partly remain in the form of an amorphous mass enveloping these crystals; in which case a mixed kind of nucleus will be formed.

2. Of the Origin of Oxalate of Lime or Mulberry Renal Concretions.—Taking for granted, as before, that the reader is acquainted with the condition of the urine, and the constitutional symptoms attending the oxalic acid diathesis; we shall proceed at once to consider the symptoms and modes of formation of oxalate of lime renal concretions.

It may at first sight appear difficult to conceive how a substance like the oxalate of lime can form a calculus at all; since in our hands, this salt exists only in the form of a powder, little soluble in water, and quite incapable of concreting, or of assuming the massive crystallized form. That the oxalate of lime, however, is not only capable of forming amorphous, but crystallized concretions of considerable magnitude, is sufficiently obvious, from a very superficial examination of mulberry concretions; and perhaps the following observations may throw some light on the modes in which these varieties are produced.

Whether the oxalic acid be taken as food, or eliminated during the assimilating processes, still the quantity compared with the bulk of the articles with which it is mixed, is comparatively small, and in all ordinary cases, it seems to pass off, whether associated with lime or not, in a state of solution in the acid urine in which it is secreted. When, however, the proportion of the oxalic acid is greater than usual, or when from any cause the urine becomes alkaline, the oxalate of lime, no longer under vital control, and becoming incapable of being held in solution in the urine, is precipitated in the kidney; and when once, even the most minute solid particle is thus deposited, it is quite sufficient to constitute a nucleus, around which future accretion will take place.* This is *one* of the modes in which renal concretions of the oxalate of lime may be supposed to be

* In certain diseases of the kidney, as we have elsewhere shown, minute crystals of the oxalate of lime are occasionally seen in the *tubuli uriniferi*.

formed; but the most frequent mode in which such concretions are formed, appears to involve another principle.

We have elsewhere stated, that in certain states of the system frequently connected with cutaneous disease, and with the presence of oxalic acid, the mucous membranes of the urinary organs, and particularly of the kidneys, are disposed to throw off large quantities of lime, either in the shape of carbonate or phosphato of lime, or of a mixture of the two.* Now, when this is the case, and when oxalic acid, in any state of combination, is at the same time eliminated by the kidney, the formation of an oxalate of lime concretion is inevitable; for from the great excess of lime present, and from the tendency in the urine to alkalescence on such occasions, the oxalate of lime formed, no longer capable of being retained in solution, is deposited in the solid form; and thus, as before, affords a nucleus around which other portions of the salt either rapidly concrete in the amorphous form; or more slowly in the crystallized form; according as the oxalic acid and the lime may happen to be more or less abundant. Such appears, as just stated, to be the most frequent mode in which the formation of an oxalate of lime concretion is formed in the kidney. In other instances, a particle of blood, or perhaps of the epithelium of the mucous membrane lining the cavities of the kidney, may constitute the primary nucleus of the concretion. This may be supposed to be the mode in which renal oxalate of lime concretions are produced, after inflammatory attacks or injuries of the kidney, of which I have seen repeated instances; for during such conditions or injuries of the kidney, blood, &c., are not unfrequently thrown off from the excited or injured mucous membrane. In all these, and other instances that might be related, the formation of an oxalate of lime concretion obviously requires the concurrence of other causes besides the mere presence of oxalic acid in the urine; and hence, as elsewhere stated, the formation of such concretions is, for the most part, purely accidental, and by no means commensurate with the frequency of the diathesis in different individuals.

3. *Of the origin of Cystic Oxide renal Concretions.*—The cystic oxide form of calculus is so rare that we can say but little

* See pages 283, 284.

respecting it; but from the history we have given of cystic oxide concretions, as well as from the peculiar properties of the substance, there can be little difficulty in conceiving how concretions can be formed from it in the kidney. The plastic nature of cystic oxide, while it favours the formation of concretions, is unfavourable to their escape; for a substance of moderate size and hardness may be supposed to pass much more readily through a muscular canal, than a plastic mass yielding to pressure, and capable of assuming the irregular forms of the canal itself.

4. *Of the origin of Phosphatic renal Concretions.*—Nephritic calculi composed of the phosphates are not of common occurrence, and in almost all instances their immediate nucleus consists of the carbonate or phosphate of lime, or a mixture of both. In general also these two substances predominate throughout the calculus; and, except in a few rare instances, the proportion of the triple phosphate present in such calculi is far below the average. The rationale of these remarks will be readily understood by those who have perused the foregoing pages, and borne in mind what has been said on the subject of the pathology of incidental principles. I have seen very few instances of renal calculi composed of the phosphates, in which the mucous membrane lining the cavities of the kidney has not been in that peculiar state of disease formerly noticed, in which it throws off calcareous matter either in the state of carbonate or of phosphate; * and though phosphatic renal calculi *may* be occasionally of urinary origin, yet I am satisfied that such an origin of these concretions is of uncommon occurrence; and that they are most usually formed from the mucous membrane lining the cavities of the kidney in the manner stated. On these grounds we can account for the comparative absence of the triple phosphate of magnesia and ammonia; which is most frequently of *urinary* origin; and only begins to be associated with the calcareous salts, when they have formed a mass so large as to disturb the functions of the kidney; and thus to cause the urine to abound in, or rather to deposit, the triple phosphate.† In two or

* See pages 283, 284.

† Many years ago, I examined the body of a gentleman who during the greater part of his life had suffered from renal disease, remarkable for being attended by the secretion of large quantities of the earthy phosphates. Both kidneys were not only extensively disorganized; but most of the natural

three renal calculi composed chiefly of the triple phosphate, which I have seen, there appeared to be a foreign nucleus, around which the triple phosphate was collected. I am ignorant of the history of these cases; but think it not improbable that the patients, among other things, had been taking alkalies too freely; which caused an excess of the triple phosphate to abound in the urine.

Such is a summary account of the formation of the different varieties of renal calculi, as founded partly on their structure, and partly on the pathology of the principles of which they are composed. Did our space allow, innumerable illustrations of the general accuracy of the opinions above advanced might be given; but I hasten to consider the subject in another point of view.

SECTION II.—*Of the Symptoms and Treatment of Renal Concretions in general.*

THE subject of renal concretions is naturally divided into two parts, viz. *the symptoms, &c., they produce while in the kidney;* and *the symptoms they produce during their passage from the kidney down the ureter to the bladder.*

Of the Symptoms produced by the presence of Concretions in the Kidney.—The most frequent symptoms produced by the presence of foreign bodies in the kidney, are—*pain in the region of the organs;* *disturbance of the functions of the stomach,* usually

cavities, as well as many cysts, were found distended with numerous earthy concretions of various sizes and composition. The concretions found in those cavities *to which the urine had access,* consisted of the phosphate and carbonate of lime, and more or less of the triple phosphate of magnesia and ammonia: while those cavities or cysts distinct from the renal structure, and to which, therefore, *the urine had no access,* consisted of the calcareous phosphate and carbonate only, without any admixture of the triple phosphate. This case forcibly arrested my attention at the time; and indeed was one of the first circumstances that led me to the views advanced in this treatise respecting the pathology of the phosphates.

accompanied by *nausea* and *vomiting*; uneasy sensations, and painful retraction of the *testes*; and *bloody* urine. Each of these symptoms is liable to be very much modified according to the size and nature of the concretion, the peculiar constitution of the patient, and a variety of other circumstances; as in the next place we shall attempt to show.

The *pain* produced by the presence of renal concretions differs almost infinitely both in kind and degree. I have known patients who were constantly passing renal concretions of considerable magnitude, declare that they felt no pain from them whatever; and that if they had not seen the concretions, they would have been unconscious of their existence. I have seen other instances, in which the presence of a small concretion in the kidney has given occasion to very great suffering or uneasiness about the back, for a long time before it has descended from that organ into the bladder. In these cases the differences could neither depend on the nature of the concretion, nor on its size; for the concretion has in both instances consisted of lithic acid, and the least concretion produced the greatest pain. Still the nature of the concretion and its magnitude, other things being equal, have doubtless a great effect in modifying the nature and the degree of the pain. Generally speaking, perhaps, concretions of the lithic acid produce least pain; and the pain, when it does occur from such concretion, is often dull and oppressive, with a sense of weight; of the gouty and rheumatic kind; and accompanied by congestion and derangement of the hepatic system. Indeed the pain in general from lithic acid concretions, may be said to bear a certain relation to the constitutional disturbance; that is, to the activity of the gouty or rheumatic diathesis, and to the hepatic derangements present; especially about the middle period of life, when such affections, as was formerly stated, first begin to make inroads on the system. The presence of concretions of the oxalate of lime in the kidney often produces great pain and constitutional derangement; but the pain and derangement usually assume characters different from the pain and derangement attending lithic acid concretions. The pain is generally of a more acute character; and though principally referred to a particular spot over the region of the kidney, is often discursive, and shoots in the direction of the ureter, epigastrium, or shoulder. The constitutional symptoms

also partake of the irritable, rather than of the congestive and inflammatory character—in short, present all the peculiarities of the oxalate of lime diathesis formerly noticed; and which need not be repeated. I am not aware of any peculiarity in the pain of the back, produced by cystic oxide concretions in the kidney; further than that it is often severe and distressing, and not necessarily characterised either by gout, rheumatism, or irritability. The existence of concretions of the phosphates in the kidney is sometimes attended by great suffering. The pain, which is almost unremitting, is apt at intervals to assume an aggravated form, so that the affection becomes paroxysmal. I have more frequently noticed this form of concretion to be accompanied by a distressing sense of burning heat in the back, than either of the other forms of calculus; though this is a symptom occasionally occurring in all the varieties. In other respects, the pain and phenomena attendant on concretions of the phosphates closely resemble those attendant on the oxalate of lime, to which form of concretion they are for the most part pathologically related; as stated in a former chapter.

The next most constant symptom produced by the presence of concretions in the kidney, is, disturbance of the *gastric* functions, usually accompanied by *nausea* and *vomiting*. This symptom, like the pain produced by renal concretions, with which it is in a certain degree commensurate, is subject to the greatest possible variety in different instances. Those in whom lithic acid concretions do not produce pain, often escape gastric disturbance; and, as above stated, the chief disturbance in such cases usually lies below the stomach. When lithic acid renal concretions produce pain, the stomach generally sympathises in some way; and most usually by producing great acidity and its consequences. Nausea, and even vomiting, are not unfrequently occasioned by renal lithic concretions; but most commonly, when this is the case, the individuals labour at the same time under what they call a bilious attack; that is, abdominal congestion, accompanied by gouty irritation. The presence of oxalate of lime concretions in the kidney usually produce great gastric disturbance of various kinds, among which, however, nausea and vomiting, though they occasionally occur, are not the most frequent symptoms. The most usual symptoms are, great flatulence, and its consequences, *gastrodynia*,

palpitation of the heart; &c.; in short, disturbances not only of the stomach, but of the whole system, partaking of the irritable characters, formerly described as characteristic of the oxalic acid diathesis. I know of no peculiar gastric disturbance occasioned by the presence of cystic oxide concretions in the kidney. Renal concretions of the phosphates often produce considerable gastric derangements; which gastric derangements, for the reasons mentioned, usually partake more of the irritable character of those produced by the oxalate of lime, than of the congestive character of those produced by lithic acid renal concretions.

The third symptom, most usually produced by the presence of renal concretions, are painful sensations, accompanied by retraction of the *testes*. This symptom assumes a variety of forms in different instances. Sometimes, instead of pain and retraction of the testes, there is a sense of numbness, coldness, or relaxation. These, and a variety of other anomalous sensations, are not confined to the testes, but occasionally extend down the inside and front (more rarely the outside) of the thighs; and even to other parts of the body. Sometimes also, when the pain is of long duration, the testicle chiefly affected becomes swollen and tender to the touch. Indeed, I have seen several instances in which pain and swelling of the testicle constituted one of the first and most prominent symptoms produced by a renal concretion. I am not aware of the causes of these differences in this symptom; or whether this symptom be liable to be otherwise much modified by the nature of the renal calculus. I have seen many of these modifications, both present and absent, in all the varieties of concretion, and in almost every possible grade. Sometimes they have constituted one of the most troublesome indications; at other times they have been altogether absent; and that without any reasons that I could discover. Certainly, at least, neither the size nor the kind of concretion appeared to account for the modifications of the symptoms, nor for their presence or absence. It is probable, therefore, that these symptoms are connected with some accidental nervous sympathies or communications not at present understood. The passage of flatulence along those portions of the colon, in near contact with the kidney, is sometimes attended by darting pains in the testes.

The last characteristic symptom of renal concretions to be briefly noticed is *bloody urine*. This, like the preceding, is subject to great modifications. In a variety of cases of renal concretions, blood is never observed at all; in others it is almost constantly present. In congested and gouty subjects who suffer from lithic acid renal concretions, the blood often appears in the urine under the form of a dark coffee-coloured sediment, mixed with lithic acid gravel; which, after a time, subsides to the bottom of the vessel, and leaves the urine apparently little coloured. This haemorrhage is sometimes produced by very slight causes; as, for instance, by an active cathartic which had perhaps been taken to relieve a bilious attack. Occasionally the blood is more abundant; and in this case the colour is more florid, and the urine remains red, after subsidence has taken place. Perhaps, on the whole, renal concretions of the oxalate of lime are more apt to produce haemorrhage than any other variety. This may arise in part from their rough and angular forms; but the peculiar characters of the diathesis have likewise something to do with the phenomena. Thus, during the prevalence of certain epidemics, in which the tendency of this form of concretion seems to be augmented, I have seen bloody urine very common.* At other times, in sporadic cases of the oxalate of lime concretion; and in those cases in particular in which oxalic acid appears to have been formed (or introduced) into the stomach, very large crystallised concretions of the oxalate of lime, presenting sharp angular points in all directions, have been voided; during the formation, or even the passage, of which, no haemorrhage had been observed. I have never seen bloody urine accompany cystic oxide renal concretions. Renal concretions composed of the phosphates are sometimes accompanied by bloody urine; but if I were to speak from my own experience, I should say, much less frequently than some other forms of concretion.

In concluding this part of our subject, it need scarcely be observed, that the preceding remarks apply to those cases in which the degree of exercise is supposed to be moderate and equal. Violent exercise, in every instance, seldom fails to increase all the above symptoms in a greater or less degree. In these remarks,

* See page 20.

also, the concretions are supposed to be of moderate size, and not in any way connected with organic disease ; circumstances which much aggravate the symptoms, and produce others to be now briefly recited. Renal calculi, under favourable circumstances, make their escape from the cavities of the kidney, and descend into the bladder, from whence they are discharged with the urine. During their transit they produce a train of symptoms to be presently described. In the mean time, however, we shall make a few remarks on the presence of concretions in the kidney too large to be thus got rid of ; and which, from their retention in that organ, and their gradual increase in magnitude, finally destroy its functions.

'The symptoms produced by concretions in the kidneys, too large to escape, are by no means commensurate with the magnitude of the concretions. Their increase being in general very slow, the organs become accustomed to the stimulus, and gradually accommodate themselves to their pressure. During all this time, however, one or more of the symptoms above mentioned are seldom absent, particularly after exercise or exertion of any kind ; and at those periods when the functions of the digestive organs and bowels are, from any cause, disturbed. The patient, in fact, is conscious that something is wrong about the kidney ; and that he cannot take those liberties with impunity, which a perfectly healthy person can do. Yet, as just observed, an individual may pass the greater part of a long life with a very large concretion in one kidney at least, (sometimes even in both,) without being a remarkable sufferer. When the concretion, or concretions, (for sometimes there are several,) are large, they necessarily destroy, in a greater or less degree, the organization, and consequently the functions, of the kidneys. In such cases the properties of the urine are always disturbed, and besides blood, which is frequently present, there are often large quantities of other unnatural matters in the urine ; the appearances and properties of which vary somewhat according to the nature of the concretion. The nature of the concretion may be conjectured with tolerable certainty from fragments previously passed, and from the prevalent characters of the diathesis ; of which the urine, both in health and disease, generally presents the most striking characteristics. Thus, when the concretions in the kidney consist of the lithic acid, this principle,

in an impure or imperfectly developed condition, is generally mixed with the bloody and muco-purulent discharge. On the other hand, when the concretions consist of the mulberry variety, the lithic acid is not only entirely absent, but the mucous deposit, when not mixed with blood, usually assumes the form of a transparent gelatinous mass of a greenish colour; the urine also has generally a greenish whey-like tint, and is of moderate, or even low specific gravity. When blood is present in small quantity, this is apt to be almost black; and even when present in large quantity, it is usually darker coloured than the blood produced by lithic acid concretions. I have seen no instance of the presence of a large cystic oxide concretion in the kidney; but presume, that when such exists, the urine will be always found to contain more or less of this peculiar principle. When large concretions of the phosphates exist in the kidneys, the tendency of the urine to alkalescence, and the earthy deposits invariably present in a greater or less degree, are, in conjunction with the other symptoms, sufficiently characteristic of the circumstance.

The above remarks apply to the quiescent condition of large renal concretions. When from severe exercise, or from other accidental circumstances, the concretions become dislocated, they sometimes produce inflammation of the kidney and death in a very short time; and this, perhaps, is one of the most dangerous accidents to which they are liable. Thus, I have known individuals with large concretions in the kidney, after a slight fall or strain of the lumbar muscles, immediately seized with the most excruciating pain in the region of the kidneys, attended by agonizing gastric distress and vomiting, which nothing would allay. At length, after a few hours, suppression of urine, at first partial, and then complete, has supervened, and the patient has become comatose; in which condition he has expired, in spite of every attention, in a day or two after the accident. At other times, such an accident terminates more slowly, but not less surely, in extensive suppuration and destruction of the kidney; under the effects of which the patient ultimately sinks exhausted.

After what has been stated above and elsewhere, on the formation and existence of concretions in the kidneys, we need not

dwell on the causes, diagnosis, or prognosis, in such affections. We shall proceed, therefore, to consider the symptoms usually attendant on the passage of renal concretions from the kidney to the bladder; and then speak of the treatment of the whole subject of renal concretions in conjunction.

Of the descent of renal concretions from the kidney to the bladder.—As the effects produced by the descent of renal concretions from the kidney depend chiefly on the *mechanical* irritation they occasion, the symptoms produced by the different varieties of concretions closely resemble each other. We shall commence, therefore, with a detailed account of the symptoms produced by the most common variety of renal concretion, viz., the lithic acid renal concretion; and afterwards point out the most striking differences in the symptoms produced by the other concretions.

At a greater or less period after the formation of a lithic acid calculus in the kidney, but generally not till after the peculiar symptoms accompanying the formation of such a concretion have subsided, and the flow of urine has begun to assume its natural condition; the little concretion, under favourable circumstances, quits the cavity of the kidney, and entering the ureter, gives occasion to the train of symptoms to be now considered.

The attack usually commences with a sudden aggravation of all the symptoms formerly described as produced by a calculus in the kidney, viz., a most acute pain in the loins, accompanied by nausea and a tendency to fainting or rigor, which soon terminate in violent vomiting, and more or less of fever. The pain usually assumes the paroxysmal form; and, together with the sickness which accompanies it, is of such an overwhelming nature as to paralyse the stoutest individual.* During the paroxysm the bowels are apt to be much disturbed with flatulence, amounting to what has been termed nephritic colic; and the pain shoots in all directions, but particularly forward to the groin, or downward to the bladder, or even to the end of the penis. The testicle on the side affected is painfully retracted, and there is a sense of numbness or uneasiness down the inside and front of the thigh. There is a frequent tendency to pass the urine, which is usually scanty, high-coloured, or bloody, voided with pain and difficulty,

* I have known nephritic attacks accompanied by syncope, and in one or two instances by epilepsy.

and not unfrequently serous, even when blood or gravel are absent. These symptoms continue sometimes for a few hours only—sometimes for several days or even weeks; and when thus protracted, the progress of the concretion can be often gradually traced down the ureter by the shifting of the seat of the pain, and by certain modifications in its characters. On account of the peculiar form of the ureter, which is narrowest below, particularly where it communicates obliquely with the bladder, the stone usually sticks in this part with the greatest obstinacy; and produces, by its complete stoppage of the flow of urine, the most distressing symptoms. At length, during a violent paroxysm of retching, the patient experiences a sudden sensation, as if he were stabbed; and from that moment his acute pains commonly cease, the stone having suddenly slipped into the bladder. Such is the usual history of the *first* descent of a lithic acid calculus from the kidney to the bladder. In subsequent attacks, the symptoms are usually milder, and considerably modified; the ureter either having become expanded; or accustomed to the stimulus of a foreign body. Sometimes even in first attacks the symptoms are so slight as to escape notice; even when severe, they often gradually subside without any crisis; so that we are unable to determine with certainty whether the concretion has left the ureter or not. In such cases it is probable that the urine escapes by the sides of the calculus; as many of the symptoms produced by the descent of renal calculi appear to depend more upon the suppression of urine they occasion, than upon their mechanical irritation. In some instances lithic acid concretions become broken or disintegrated during their passage from the kidney; and in this case they are voided as gravel with little inconvenience.

The symptoms produced by the descent of an oxalate of lime concretion from the kidney, in most respects resemble the above, produced by a lithic acid renal concretion. The nature of the concretion may be generally inferred from the former history of the patient, and from the prevalent diathesis. The absence of lithic acid gravel in the urine, the dark colour of the blood usually present, the marked and peculiar constitutional irritation, and the severe and often protracted character of the attack, assist our diagnosis, and usually leave little doubt on the subject. I

have generally observed, also, that the pain and worry produced by the descent of an oxalate of lime concretion often remains much longer after the descent and escape of the calculus, than after the descent and escape of lithic acid concretions ; so that the patient can be scarcely persuaded that others do not remain behind—a circumstance of rather uncommon occurrence in this form of concretion ; which is usually solitary, and even under ordinary circumstances, does not recur, except after considerable intervals.

I have known great suffering produced by the descent of a renal calculus composed of the cystic oxide ; but am not aware of any peculiarity in the symptoms. The nature of the concretion can without much difficulty be determined by the state of the urine. The descent of renal concretions composed of the phosphates, often gives occasion to great and protracted misery. I once saw an attack continue for upwards of three weeks, almost without remission. At length the concretion made its escape into the bladder ; from which organ it was shortly afterwards voided with some difficulty on account of its magnitude. It is not easy in all instances to form a correct opinion of the nature of the concretion, when it consists of the phosphates ; for the irritation and excitement usually present, often cause the urine to be loaded with the lithate of ammonia. The constitutional history of the patient may throw some light on the subject. Whether the absence of blood in the urine be characteristic or not of phosphatic renal concretions, I cannot state ; but it has so happened, that in the few instances I have seen of such attacks, the urine, though sometimes scrous, has not contained blood.

After what has been stated, we need not dwell on the causes or diagnosis of nephritic attacks occasioned by the descent of renal calculi.* With respect to the prognosis, it may be stated, that viewed *mechanically*, or with reference to the possibility of their entering and passing down the ureter, everything depends on the

* The reader is referred more especially to page 266, where the symptoms produced by biliary concretions, which occasionally somewhat resemble those produced by renal concretions, are pointed out. The diagnostic differences between the symptoms produced by the descent of renal concretions, and other affections of the kidney likely to be mistaken for such an accident, will be more fully considered in the next chapter.

size and shape of the concretion. Small concretions, though productive of severe pain, are seldom dangerous; large concretions, on the contrary, by sometimes permanently sticking in the ureter, produce great constitutional irritation, and even the death of the patient. Such instances, however, are very rare, and have most usually occurred when there has been disease of the kidney; or when there has been a calculus in both ureters at the same time, and there has been from this cause a total suppression of urine. When suppression of urine takes place, the patient usually becomes comatose; in which state he expires; sometimes in convulsions. A scanty or suppressed condition of the urine, therefore, is always to be considered as a formidable symptom in nephritic attacks. Concretions too large to enter the ureter, produce a peculiar train of consequences already noticed; but to be more fully illustrated hereafter.

Of the Treatment of Renal Concretions.—The treatment of renal concretions, like their symptoms, may be conveniently considered under two heads, viz. the treatment to be adopted while they are comparatively *quiescent in the kidney*; and the treatment to be adopted to alleviate the acute symptoms they produce during their *passage down the ureter*.

When the symptoms formerly recited appear to denote the presence of concretions in the kidney, and when, from the phenomena exhibited by the urine, and from the absence of other circumstances denoting organic disease of the organ, there is reason to hope that these concretions are not of such a magnitude that their escape is impossible; one of the first objects to be attempted, is to cause their expulsion from the kidney. The means to be adopted for this purpose in the different forms of calculi are essentially the same; but vary in some minor particulars. When the concretions are of the lithic acid variety, as is by far most frequently the case, one of the earliest circumstances to be attended to, is the reduction of that congested condition of the abdominal viscera, which is usually present in this form of concretion. This may be accomplished, should the symptoms be strongly marked, by cupping freely over the loins at the outset; and afterwards by active purgatives, including calomel (and colchicum or henbane if gout be suspected, or spasmodic irritation present) conjoined with

alkaline and diuretic remedies; among which the tartrate of potash, or tartarised soda, is perhaps the most efficient. When the symptoms denoting congestion have become subdued, the patient should be put upon the plan of diet and treatment formerly mentioned, as adapted to the lithic acid diathesis; and be directed to take simple diluents freely, (such as the Malvern or effervescent waters,) in conjunction with foot or horse exercise. The degree of exercise must be always carefully limited by the degree of pain and constitutional excitement produced. Without attention to this precaution, exercise is dangerous from its liability of exciting inflammation and its consequences; when, however, the inflammatory state of the system has been previously reduced, exercise may be generally taken freely, and often with the effect of bringing away the concretions with comparatively little inconvenience. Under this plan of treatment, sometimes alternated with the cautious use of diuretics of the tercbinthine kind, I have seen almost incredible quantities of sand, and numerous lithic acid concretions, of various magnitudes, brought away, to the great relief of the patient.

If the concretions be too large to descend the ureter, which may be usually inferred from the phenomena presented by the urine; the congested state of the system, if it exists, is to be reduced as before, but with more caution; and our object should be to maintain the flow of water, but not by forcing medicines to unduly increase it; as the use of active diuretic medicines under such circumstances, is highly improper, and often dangerous. In the preceding cases, however, two great objects of the treatment will be similar; viz. to prevent the formation of new concretions in the one instance; and their increase in magnitude in the other. The means by which these objects are to be attained are the same, and have already been pointed out in our chapter on the lithic acid diathesis; to which, therefore, we refer the reader.*

When, from the history of the patient and from the characters of the urine, the concretions are presumed to be of the oxalate of lime variety; the same general principles of treatment are to be kept in view; but the means to be employed are somewhat

* See page 194.

different. That peculiar congested condition of the abdominal viscera, so usually present in middle-aged individuals labouring under lithic acid concretions, is seldom so remarkable (indeed is usually absent) in renal concretions of the oxalate of lime. Cupping and other depleting remedies, therefore, are rarely necessary, to much extent, in this form of concretion; and the symptoms we have to deal with are rather those of irritability. If the state of the urine and other circumstances denote the absence of serious organic disease, and that the calculus is of small size, means may be taken to dislodge it, if possible, from the kidney. These means may, as before, consist of diuretic purgatives; or of diuretics alone, as for instance dilute nitro-muriatic acid with nitrous æther. Sedatives, as henbane, &c., will be proper; and the warm bath, conjoined with plenty of exercise, on foot or horseback, (always stopping short of severe pain, haemorrhage, or constitutional irritation,) should be perseveringly persisted in, till the enemy be dislodged. When there is obvious organic disease in the kidney, all these means, as in the preceding case, will be improper; and our attention must be directed to prevent, as well as we can, the further increase of the calculi, by the means best calculated to obviate their formation.*

When the renal concretions consist of the cystic oxide, or of the phosphates, the same general principles of treatment should be kept in view. Inflammatory symptoms, if present, which is rarely the case, should be subdued; and if there be no signs of organic disease in the kidney, and the concretions be apparently of small size, the means adapted to remove them from the kidney should be cautiously applied. On the other hand, should symptoms of organic disease be evident, our attempts must be limited to the prevention of the future increase of the calculi, and to the counteraction of chronic inflammation. For the former of these purposes the expedients already recommended should be resorted to; † while for the latter, an issue or seton over the loins

* See page 71, where these means are pointed out.

† When the phosphatic renal concretion, as is often the case, is connected with skin disease, an alterative course of sarsaparilla, or other means adapted to the peculiar character of the cutaneous affection, may, in addition to the means formerly pointed out as adapted to this peculiar diathesis, be often superadded with excellent effect.

is often of great benefit: as will be more particularly ~~painted~~ out in the next chapter.

The treatment to be adopted during the actual descent of concretions from the kidney is essentially the same in the different species of calculi; but occasionally requires to be modified according to the presence or absence of particular symptoms. In plethoric individuals labouring under renal concretions of the lithic acid variety, the symptoms sometimes run so high, that free cupping over the loins is in the first place requisite. This may be followed by a full dose of calomel and opium; and when these means have begun to sensibly affect the system, warm fomentations, or the warm bath, may be generally recommended with great advantage. After some time, diuretic purgatives (combined with colchicum, and given in the effervescent form, if the stomach continues very irritable,) may be resorted to; for it is in this particular stage of the attack that diuretic purgatives, more than any other remedies, seem to promote the escape of the concretion.

When the concretion consists of the oxalate of lime, the constitutional symptoms are seldom so urgent, as when it consists of the lithic acid. Antiphlogistic remedies, therefore, are not required in the same degree, and often not at all; and we must trust more to sedatives and diluents. The warm bath and sedatives may, in such cases, be often employed at the very commencement of the attack; while the diluents may consist of citrate of ammonia or nitre, given in the effervescent form, and dissolved in considerable quantities of tepid water.* Much alleviation from the pain produced by renal concretions, is also sometimes obtained, by the free injection of warm water into the bowels. This remedy may be administered at first, with the view of clearing the bowels; and afterwards, if necessary, repeated with the addition of sedatives. In protracted cases of suffering from renal calculi composed of the oxalate of lime and the phosphates, I have occasionally known the greatest relief from that intolerable burning

* Perhaps the best mode of administering this form of remedy is to heat a small quantity of a strong solution of the citrate of ammonia or of nitre nearly boiling hot, and then to add to it such a quantity of some effervescent water as shall make the mixture blood warm.

sensation of which patients sometimes complain in these forms of concretion, obtained by the application of pounded ice to the region of the kidney. I first took the hint from a patient who always applied it in his own case with the best effect. I apprehend, however, that the practice should be limited to the forms of calculi mentioned, and should hesitate to have recourse to it in plethoric gouty individuals labouring under lithic acid renal calculi. In such, and indeed in all cases, the application of fomentations as hot as the skin will tolerate them, is the safest expedient, and seldom fails to give temporary relief.

Such are the most usual means to be resorted to during the descent of renal calculi from the kidney. As already stated, these symptoms often terminate of their own accord by the escape of the calculus into the bladder; sometimes, however, it happens, with the lithic acid calculi more especially, that when one calculus escapes, others follow in quick succession, so as to constitute a number of attacks more or less acute. In cases also of the oxalate of lime and phosphatic concretion, uneasiness often prevails about the kidney and bladder long after the calculus has escaped from the latter organ; so that the patient is apprehensive that others remain. Nor is it easy, in all instances, to determine this point; though, as already stated, the probability, with regard to the oxalate of lime concretion, in particular, is against the supposition that other concretions remain.

CHAPTER II.

OF DISEASES OF THE KIDNEY, PRODUCED BY, AND LIABLE TO BE
 CONFOUNDED, OR ASSOCIATED WITH CALCULUS IN THESE ORGANS;
 AND OF THE TREATMENT OF SUCH DISEASES.

THE disease most likely to be produced by, and confounded or associated with, renal concretions; is inflammation of the kidney, either in its acute or chronic form ; this, therefore, will occupy our attention in the first place. We shall afterwards briefly consider, under a second general head, the diseases resulting from acute and chronic inflammation of the kidney ; and from the mechanical irritation produced by a calculus, or other degenerating influences on that organ.*

Of Acute Inflammation of the Kidney.—All writers agree that idiopathic *nephritis*, or acute inflammation of the substance of the kidney, is a very rare disease, at least in this country. This accords with my experience ; for during the long time my attention has been directed to these diseases, I have only seen two or three well-marked instances, and am not able to speak with much precision of more than one case.† Like other

* The arrangement of inflammation among mechanical diseases has been the subject of pseudo-criticism. When the learned critic has condescended to inform me what *he* knows (i. e. *understands*) of inflammation beyond its mechanical phenomena, I may be inclined to listen to him.

† Unfortunately the memoranda of this case, which occurred to me many years ago, have been mislaid ; so that I can only state the general circumstances. The patient was a servant, a young man about thirty years of age, not subject to gout or rheumatism, and apparently sober and healthy. The affection was stated to have commenced with the symptoms recited in the text. After it had existed for some time, medical aid was called in, and he was actively treated. I then saw him once, I believe, only. At that time he

acute attacks of inflammation, acute nephritis usually commences with rigor, which is soon followed by all the usual concomitants of fever. This fever is sometimes of a highly phlogistic character; sometimes only moderate; but in all instances is marked by decided hardness of pulse. There is acute burning pain in the region of one or both kidneys, accompanied by thirst, anxiety, restlessness, colicky pains with constipation of the bowels for the most part, and sickness and vomiting. The urine, which at first is of a deep red colour, is said, as the disease proceeds, to become limpid and colourless; and in the height of the disease, there is a frequent desire to pass it, but with very little effect; and sometimes, when both kidneys are affected, there is a total suppression; in which case a fatal coma soon supervenes.

Such are the most frequent symptoms stated to be produced by acute nephritis; and though they resemble in some respects the symptoms formerly pointed out as accompanying the nephritis attended by acute anasarca, yet there are many points of distinction. That acute nephritis can exist without anasarca, I have not, from what I have seen, the least doubt. It is evident, therefore, that the cause producing acute anasarca involves the whole system, and the kidneys among the rest; while simple inflammation, if confined to the kidneys alone, does not necessarily produce anasarca.* The urine in acute nephritis is said by some, like the urine in acute anasarca, to be serous. On this point I regret that I cannot speak with much certainty. The urine in the case of acute nephritis, of which a few particulars have been given in a preceding note, was very little if at all serous, at the time I examined it. Whether it had been albuminous before, or whether it became albuminous in subsequent stages of the complained of constant acute burning pain in the region of the kidney. There was no anasarca; nor, as far as I recollect, any other striking symptoms. The urine was not remarkably scanty; but it was of a deep blood-red colour, transparent, and little if at all serous. He died some days after; and the body was examined. The kidneys alone were found to be affected, and these were both much enlarged, and in a most intense state of inflammation throughout their whole substance. So much I remember; but I regret that I cannot, for the reasons stated, safely enter into further details, either as to the cause, symptoms, circumstances attending the fatal result, or the appearances found after death; all of which, however, I remember generally to have been interesting and instructive.

* See page 121, et seq.

affection, I am unable to state. M. Rayer observes, that a serous condition of the urine in simple nephritis is accidental and occasional only."*

Authors speak of gouty and rheumatic nephritis, as opposed to simple or idiopathic nephritis. That such modifications of the disease exist both in the acute and chronic form, there can be no doubt. Indeed what may be, and is, usually called *chronic nephritis*, is most commonly connected with a gouty diathesis, and the formation of lithic acid and gravel or concretions; and in different instances of such affections the symptoms vary in every possible degree, from those of simple irritation or low chronic inflammation of the kidney, up to the most acute forms of nephritis above described.† The presence of gouty nephritis may be generally ascertained from the previous history and age of the patient; and these circumstances, and the symptoms usually attending it, are commonly so unequivocal as to leave little doubt about the diagnosis. Gouty nephritis almost always terminates in the formation of renal concretions of lithic acid; even if the patient had never before been subject to the affection. Moreover, when gouty individuals in early life have suffered from inflammatory attacks about the kidneys arising from mechanical injuries, or from any other cause, they are almost certain, in middle age, to get nephritic attacks more or less of the inflammatory kind, and attended by the formation of lithic acid gravel or concretions. In most of these cases the uneasiness about the back is increased by pressure or percussion.

Rheumatic nephritis, if it exists at all, is a very rare disease, and I am not sure if I have ever seen a case which could with propriety be classed under this head. I have indeed, in a great many instances, seen attacks of lithic acid gravel, &c., accompanied by more or less of nephritis in individuals who were subject to what they called rheumatism; but, for the reasons formerly stated, I have in all these cases considered the attacks to partake of the gouty, rather than of the rheumatic character.‡ The nearest

* Vol. i. p. 303.

† The reader is referred to what has been already stated at pages 203 and 322 for the symptoms usually accompanying nephritic attacks accompanied by lithic acid gravel and concretions.

‡ See page 209, where I have considered gout as connected with albumi-

approaches to what I have considered as rheumatic nephritis, have occurred in some of the milder cases of anasarca, accompanied by serous urine, and produced by exposure to cold. In such cases the anasarcaous swellings are often tender to the touch, and shift about from one place to another, without reference to the laws of gravity, very like rheumatic oedema. Such cases I have considered to partake of the rheumatic character; and have sometimes thought that even acute anasarca itself, might not be unreasonably referred to the universal inflammation of the same tissues which are usually the seat of common rheumatism.

Other forms of nephritis both acute and chronic are mentioned by authors; but the few remarks to be offered respecting them will perhaps be more appropriately made under the head of the *causes* of nephritis to be in the next place considered.

Nephritis occurs most frequently, as we have stated, in those who labour under gouty and rheumatic predisposition, and the immediate exciting cause, in by far the greater number of instances, is exposure to cold. Other predisposing, as well as exciting causes are various accidents or injuries affecting the kidney or its neighbourhood, and more especially the bladder. Also certain febrile diseases, particularly those of the exanthematous kind, as scarlatina, measles, certain fevers of the typhoid form, &c., in all which the kidneys often become deeply involved. Among the causes operating from within, may be mentioned stimulating articles, as cantharides, turpentine, the different balsams, &c. Also the free or habitual use of ardent spirits; the effects of

nous, and rheumatism with gelatinous disease or derangement; and the one consequently, as manifested more especially by the lithic, the other by the lactic, acids. It may be remarked, however, that one of these tissues is seldom affected alone, without involving the other; and hence the frequency of what is perhaps properly called *rheumatic gout*, particularly in strumous subjects. Moreover, it may be remarked that the deposition and formation of *free* lithic and lactic acids in the urine, &c., are not to be considered as necessarily commensurate with the severity of the affections; these two acids being generally more or less neutralised, after, or at the commencement of their formation, by the ammonia derived from urea, or by the soda derived from the blood. Lactic acid does not exert in *healthy* urine according to Liebig.

which, more especially on the kidneys, have been already pointed out, under the head of serous urine. Another fertile exciting cause of nephritis, is bladder affections; as we shall show in a future chapter.

Inflammation of the kidney in favourable cases naturally terminates in *resolution*, sometimes accompanied by a discharge of blood, &c.; but it is liable to be followed by all the usual consequences of inflammation in other parts of the body; such as *suppuration* and *abscess*; *obliteration of structure*; *gangrene*, &c.; on which we have in the next place to make a few remarks.

Suppuration and Abscess of the Kidney.—Inflammation of the kidney, when about to terminate favourably, is sometimes, as above mentioned, accompanied by a discharge of blood, or other matters of an indefinable, but critical, nature, in the urine. When this desirable event does not take place, and when, in spite of all the means employed to prevent such a termination, nephritis ends in suppuration or abscess, the circumstance is usually indicated by rigors followed by febrile exacerbations and sweatings—in short, by all the symptoms of hectic. The urine, at the same time, becomes loaded with pus, or purulent looking mucus; which frequently, by its unnatural properties, produces much irritation in the bladder and urethra; as will be noticed more particularly in the next chapter. In other instances, the urine remains for some time clear, and the patient complains of a dull pain with a sense of fulness and weight in the loins, and more or less of gastric disorder. In this case the presence of an abscess in the kidney may be suspected; which after a time commonly bursts suddenly into the cavity of the kidney; when large quantities of pus, occasionally mixed with blood, gravel, &c., appear in the urine, and during their passage, "occasion considerable suffering to the patient."

We have already stated, that suppuration and abscess of the kidney are almost always associated with, if not produced by, inflammatory excitement of the kidney caused by urinary concretions; and that, in such instances, the calculi often go on increasing in magnitude, till the kidney is wholly destroyed. Sometimes in these and similar cases, the ureter becomes partially or entirely obliterated either by the presence of concre-

tions or other causes. In such cases of course the pus cannot escape, at least in any quantity; and the patient is either cut off after a short illness; or sometimes continues to suffer for years a variety of distressing symptoms. In a few such cases the abscess has been known to point outwardly to the loins or back, where its purulent contents, sometimes mixed with calculi, have been discharged; and the patient, after much protracted misery, has either sunk under the affection, or occasionally experienced a partial recovery.* In a few instances, the abscess

* I once saw an instance of this kind in a young man of a strumous habit, in whom the affection of the kidney, I believe, had been first brought on by a neglected stricture. In this case an immense abscess made its appearance externally over the region of the left kidney, after a severe and decided nephritic attack, accompanied by serous and purulent urine. This abscess, which was supposed to be connected with the kidney, was opened artificially, and a large discharge of fetid pus took place. After a long state of suffering, the abscess gradually healed, and the patient recovered his health to a considerable extent; though the urine always remained serous. In April, 1841, he had another attack, which after much suffering proved fatal; and Mr. Powell, of Coram Street, who examined the body, kindly furnished me with the *post-mortem* phenomena, of which the following is a condensed abstract: "Over the region of the left kidney and psoas muscle there was a large fluctuating protuberance. At this part, the peritoneum was thickened and opaque; and between it and the fascia, there was a very dense deposition nearly half an inch thick. The ureter of this side was found as an impervious cord. On cutting through the fascia, a large abscess was found enveloping the whole of the psoas muscle, and extending up to the body of the tenth dorsal vertebra, and downwards through the crural arch into the thigh, and proceeding to the back part of this, for about eight inches below Poupart's ligament. No vestige of the psoas muscle, or of the left kidney remained, and the whole of their position was occupied by pus; through which the anterior crural nerve passed in quite a denuded state. The vertebrae were not diseased; though the ligaments of the lumbar vertebrae appeared more relaxed than natural. The right kidney was large and flabby, and easily divested of its membrane. Thus exposed, its surface was granulated, and its shape slightly lobular. The pelvis was large and vascular, and thickly studded with vesicles containing a transparent yellowish fluid. The vascularity and vesicles extended throughout the ureter; but in a diminished degree at its lower part. The coats of the bladder were thickened, and the sub-mucous layer was very vascular; but the vesicular condition of the ureter did not extend to this organ. Prostate healthy. The liver was generally enlarged, weighing about seven pounds. Its consistence was firm, and the enlargement appeared to be the result of hypertrophy of all the tissues. Stomach vascular, and its

has been known to burst into the abdominal cavity and prove quickly fatal. In the majority of cases of the present description, the ureter remains more or less pervious; and the patient continues to discharge purulent matter, almost constantly, during the remainder of his life. Instances of this kind have been already alluded to in a former part of the present volume; to which the reader is referred for further particulars respecting the properties of the urine and the phenomena found after death, in these and similar affections.*

coats rather thickened. Pancreas healthy, with the exception of a cartilaginous deposit at its left extremity nearly a quarter of an inch thick. Spleen very large, and containing a red purulent-like matter. Its coat thickened and opaque."

* See p. 156. Sir B. Brodie observes, that when the ureter from any cause becomes obliterated, the kidney may be expanded by the urinous and purulent accumulation into a large bag or cyst, and thus form a tumour which may be felt externally in thin persons: and further, that tumours having this origin may occasionally disappear, their contents, after a time, being removed by absorption. In such cases the enlarged cyst gradually contracts till it becomes a mere capsule, in which the calculus, that, perhaps, originally caused the affection, remains imbedded. *Lectures on Diseases of the Urinary Organs*, page 237; third edition. Since the last edition of this work was published, I have seen a remarkable instance of this kind. The patient was a lady past the middle age, who for many years of her life suffered from nephritic disease, apparently in the form of abscess, forming a distinct tumour in the region of the kidney affected. During her long illness she suffered partial remissions: but the present attack for which I was called to see her had been more than usually severe. At this time there was a large and distinct tumour in the region of one kidney, and the urine was loaded with an immense quantity of foetid purulent matter. Means suited to the case, but without any hope of much amendment, were recommended and steadily pursued. She became gradually better, the tumour lessened and nearly disappeared; and the urine was free from purulent matter and almost natural; so that she was able to come from a distance in the country to London, a journey she had not been able to take for a great many years. She continued in this state for some months; when after taking a drive in her carriage, she was suddenly seized with most acute pain, and all the symptoms of a nephritic attack in the other kidney. The symptoms continued in spite of every means; complete suppression of urine, the most violent vomiting, and at length coma, came on, which speedily proved fatal. On examination of the body the kidney so long the seat of disease, as well as the ureter, were obliterated, and in their place, was found a large irregular calculus consisting chiefly of the phosphates; but all here was quiescent. In the other kidney

Indurated Obliteration of structure is another consequence of nephritis, mentioned by different authors. Such appearances have been found after death; but the characteristic symptoms attending them are unknown.

Violent inflammation of the kidney has also been known to end in *gangrene*, in some very rare instances. This unfortunate event is indicated by the usual symptoms of the same termination in other parts of the body. The pain ceases more or less suddenly, the pulse sinks, and the fatal termination of the disease is speedy and inevitable.

The above varieties of inflammation are principally confined to the substance of the kidney itself, and only secondarily involve the membranes covering the organ externally, or lining it internally. M. Rayer, I believe for the first time, has given the appellation of *Pyelitis* to inflammatory excitement of the mucous membrane lining the pelvis and other cavities of the kidney, and accompanied by an increased discharge of mucus, diseased epithelium, or muco-purulent matter in the urine—a disease, the existence of which has been long suspected, or rather known, but which had not been distinguished by any peculiar appellation. M. Rayer's name is a very good one, and I shall adopt it.

Pyelitis assumes various forms according to its degree and other circumstances. It most usually accompanies *catarrhus vesicæ*, or inflammation of the mucous membrane of the bladder, especially when severe; it seems also to occur occasionally in some forms of gonorrhœa, particularly when they have been suddenly checked by astringent injections, &c. The symptoms are usually more or less of pain, uneasiness, and sense of heat in the back, which are accompanied by low febrile action, and by nausea and sympathetic irritation of the testicles; particularly when the secretion of mucus or muco-purulent matter is unusually large. When the affection is complicated with catarrh of the bladder, the symptoms above mentioned are usually referred to that affection; and indeed, they are with difficulty distinguished from the symptoms produced by the bladder disease. Pyelitis, therefore, is in was found the cause of death. There, two or three small calculi consisting of the phosphates, were found; one of which had got into the ureter, and, by completely blocking up that passage, produced suppression of urine and death.

general seen in its most characteristic and best marked forms, when the cause is local, or lies in the kidney itself; as, for instance, when the affection arises from the irritation caused by renal concretions; or is connected, as it sometimes is, with certain cutaneous disorders, more especially affecting the neighbourhood of the urinary organs, and remotely allied to syphilis or the oxalic acid diathesis.

When pyelitis arises from the presence of calculous concretions in the kidney, the usual symptoms produced by these bodies are present; but the properties of the urine, and particularly of the mucous deposit, vary considerably. When the concretion consists of the lithic acid, the quantity of mucus in the urine, though considerable, is not so striking and characteristic, as it sometimes is when the concretion consists of the oxalate of lime. This arises partly, perhaps, from the diminished quantity of mucus secreted; and partly from the quantity of lithate of ammonia and other matters usually present, which involve and conceal it. When the calculus consists of the oxalate of lime, the mucus is occasionally voided in large transparent greenish gelatinous masses or lumps of considerable tenacity, which sometimes, in passing down the ureter, excite all the acute symptoms and suffering produced by a renal concretion. When the renal concretion consists of the phosphate of lime, the symptoms are much the same, and the mucus, or muco-purulent matter, often contains the earthy matter intermixed with it in considerable quantity. As the cutaneous affections above alluded to are often connected with oxalate of lime or phosphatic concretions, it is not easy to say whether such concretions be, or be not, the immediate cause of the inflammatory excitement. I think, however, I have seen many instances of large mucous and muco-purulent discharges from the kidneys, when the cause has not been concretions; but some chronic disease of the mucous membrane lining the pelvis, &c., of the kidney, and occasionally alternating with external cutaneous affections. The sufferings from pyelitis, particularly when complicated with diseased kidney, and permanently serous urine, are often, in common with these symptoms, referred to the neck of the bladder or urethra; and are little felt in the region of the kidneys; as will be more particularly shown in a subsequent chapter. Other

forms of pyclitis have been considered under the heads of *serous* urine, to which the reader is referred.

With respect to the inflammation of the *external* membrane of the kidney, I am not aware that there is such a specific disease. This membrane is indeed often involved in inflammation spreading from the kidney to the neighbouring parts, and *vice versa*; but I have seen no instance in which the inflammation could be said to have originated in this membrane.

Besides these affections of the kidney, which constitute the usual forms and consequences of inflammation, a variety of other chronic diseases of that organ have been noticed by different authors, the peculiar symptoms and formidable characters of which are so obscure, and urgent, that little with certainty can be predicated of them; except that nothing can be done towards their cure, and that they must inevitably prove fatal. Such are the various forms of malignant disease,—*fungus haematodes*, cancer, &c. Occasionally also the kidneys are found to contain hydatids, worms, hairs, &c.; and the nature of these affections is sometimes rendered evident during life by the discharge of such animals and matters with the urine.* Instances of all these and many other rare and anomalous affections of the kidneys will be found in the works of the authors referred to below, as well as of other writers; which it would be foreign to our present object to detail. We shall briefly allude to some of these affections, in the next paragraph; in which, in conjunction with a group of affections, about which medical men are often consulted under the familiar appellation of *Pains in the back*, the subject of *diagnosis* will be generally considered.

Patients often complain of pain and uneasiness about the back and loins, accompanied by various anomalous sensations, which cause them to apprehend that stone, or some worse affection, exists in the kidneys. Many of these sensations are merely symptomatic, or of a muscular character; others are of so doubtful or anomalous a description, that it is very difficult to determine what they indicate; and it is with a view of discriminating among these various symptoms, that I have thought it proper

* See Baillie's *Morbid Anatomy*. Chopart *Traité des Maladies des Voies Urinaires, &c.*

to consider the subject of diagnosis in the present somewhat unusual form.

When there is acute pain of recent origin in the region of the kidneys, increased by pressure, and accompanied by severe symptomatic fever and derangement of the stomach, with scanty, high-coloured, and acid urine, there is reason to suspect the presence of inflammatory action, either in the kidneys or their immediate neighbourhood. When, in conjunction with more or less of the above symptoms, the pain extends downwards and forwards towards the groin, and is accompanied by retraction of the testicle, and numbness in the thigh of the same side, with pain or tenderness just above the pubes, and bloody urine, there is reason to suspect the presence of a calculus in the kidney or ureter. If the patient has never passed gravel of any sort; if he be subject more especially to irritable stomachic dyspepsia accompanied by much flatulence and irregular action of the heart; if he labours under eruptions of the scaly kind, or troublesome indolent boils; if the urine be generally transparent and of a citron tint, rather copious, and not remarkably acid, there is reason to suspect that the calculus is of the mulberry variety. If in conjunction with the usual symptoms of renal calculus the urine be found to contain the cystic oxide, the calculus will probably consist of this substance. Lastly, if the constitutional irritation be unusually urgent, and the pain of a burning character; if the patient labours under cutaneous disease about the scrotum or its neighbourhood; if the urine be pale coloured, alkaline, and abounding in the phosphates, the calculus will be most probably found to consist chiefly of the phosphate of lime.

The above symptoms render the presence of calculus in the kidney or ureter either unequivocal or very probable; but there is a great variety of anomalous affections in which, from the absence frequently of one or more of the characteristic symptoms, it becomes almost impossible to arrive at any certain determination on the point. Among such affections, one perhaps of the most striking, as well as the most common, is the following:

A middle-aged individual, who has lived an indolent and luxurious life, after some slight disorder of the bowels or exposure to cold, begins to complain of uneasiness in the region

of the kidneys, which gradually increases and extends forwards and downwards to the groin and testicle. The stomach now frequently sympathises, and there is either absolute nausea or at least inability to take food. The tongue is much furred; there is thirst; the pulse is full, strong and usually accelerated; and there is a tendency to drowsiness and headache. In conjunction with these symptoms the patient complains of a frequent desire to pass his urine: which is scanty, high-coloured, unusually acid, often loaded with bile; and deposits large quantities of the lateritious sediments. Under these circumstances the urinary symptoms sometimes increase to a great degree of severity; and the secretion is passed in small quantities at a time, and with urgent burning sensations of the most painful kind. All these symptoms may go on for several days *without intermission*, if not interfered with; but if appropriately treated, they usually yield immediately and completely, and very often without the passage of gravel, or any other apparent critical discharge with the urine. Attacks of this description constitute modifications of what are called *bilious* attacks; and most usually occur in those who inherit, or who have produced for themselves, a strong predisposition to gout. In such attacks it is often extremely difficult to arrive at a just conclusion; for during precisely similar conditions of the system, lithic acid concretions are usually deposited in the kidney: as formerly mentioned.* It should always, therefore, be borne in mind, that such attacks denote at least a *tendency* to form a calculus; and consequently that during their continuance, a lithic acid nucleus *may* be quietly deposited in the kidney, which may descend from that organ at some future time.

In such perplexing cases, the following points will perhaps in some degree assist us in forming our diagnosis as well as prognosis;—first, the unremitting character of the pain, &c., and the obviously congested state of the abdominal viscera; in short, the unequivocal *bilious* nature of the attack,—a condition of things which, though present during the *deposition* of a lithic acid calculus; is most usually absent during a simple nephritic attack, produced by the mere *descent* of a concretion from the

* See page 202.

kidney. Secondly, with regard to the prognosis, much will depend on the period and mode, at which the attack has been treated. If promptly met at the very outset by the appropriate treatment, the deposition of lithic acid in the kidney will be either prevented or brought away in a state of hydrate or small grains; on the contrary, if the attack be permitted to go on for some days, or be injudiciously managed, the deposition of lithic acid in the kidney will have time to consolidate, and the formation of a renal calculus will be almost inevitable.

Other symptoms of a still more equivocal character, and which may or may not be connected with renal calculus, particularly of the mulberry variety, are—a constant sensation of soreness, heat, or chilliness about the spine, loins, sacrum, &c., in some instances much increased by pressure, and accompanied by shooting pains and a sense of heat or flushing extending to various parts of the body; sometimes by an occasional sensation of a rush of blood to the head, with *tinnitus aurium*; also with various nervous affections in different parts of the body, as pain and soreness in the epigastric region, along the course of the nerves of the arm, thigh, &c. These and a variety of similar symptoms are always accompanied by great derangement of the assimilating functions, and a very unnatural condition of the urine; of which, however severe they may appear to be, they are often only symptomatic. They occur most frequently in middle-aged individuals, labouring under hypochondriasis, and are often connected, or alternate with, cutaneous indications; and in those who have never had gout, but who inherit a disposition to that affection. I have known similar symptoms also frequently occur in individuals who have spent a large portion of their lives in warm climates; and in such, the right side in particular has been most frequently affected. Hence the idea that the affection was connected with hepatic disease, and mercury has been given freely, but too frequently with very little advantage, and often with decidedly bad effects; especially in those cases in which the affection has been obviously connected with derangement of saccharine assimilation.

The symptoms above mentioned are sometimes associated with, or assume the form of lumbago, or neuralgic disorder of the muscles or nerves of the back. In this case, they are generally

much increased on motion. There are many exceptions, however, to this remark, and frequent instances occur in which, after the first excitement of exercise has subsided, the continuance of it has removed, for the time, the pain altogether. In such cases, one would hardly suspect the presence of calculus in the kidney; yet I have known the above circumstances occur, when in conjunction with the other symptoms, those of the presence of a calculus seemed unequivocal. I mention this to show how exceedingly difficult it is to form a satisfactory notion of the precise nature of the affection in many of these cases; and how guarded we should be in our diagnosis, as well as prognosis. I have known such, or similar sensations about the back and loins, continue in a greater or less degree for many years in spite of every remedy; and have generally observed that they have ultimately terminated critically, and often unfavourably. Thus they have occasionally terminated (sometimes fatally) by a sudden determination of blood to the head, or some other part; or by an irregular attack of gout. I have seen a few such cases terminate in spinal and psoas disease; and once or twice have known analogous symptoms precede or accompany the early development of a malignant tumour in the neighbourhood of the kidney; which has ultimately involved, not only the kidney, but the whole of the neighbouring viscera, and, after the most intense suffering, proved fatal.* In some cases, such indications have been followed by

All the instances I have seen of such cases, have occurred in individuals of cachectic habit, and obviously predisposed to such diseases. I have had no opportunity of determining with absolute certainty, which organ has been *primarily* affected; but I believe in every instance the kidney has been first involved, and that the disease has spread or been propagated from this organ. Certainly, at least, the urinary symptoms have long preceded the other symptoms: and in one or two of the cases, had not only existed from a very early period, but were of such a kind as to place a diseased state of the kidney beyond a doubt. In the case of malignant disease alluded to, I had foretold the nature of the affection from the properties of the urine long before (judging from symptoms) it had spread to the neighbouring organs—an event subsequently marked by great and overwhelming aggravation of all the patient's sufferings. In another case terminating in spinal and psoas disease, the history of the patient and the state of his urine clearly showed that kidney disease had existed from an early period of his life.

It is remarkable how fallacious and deceptive these sympathetic pains about

the escape of a small mulberry calculus: and in one instance, after no less than eleven years of suffering from symptoms of the above description, the case terminated in this manner, and the patient became comparatively well for a time; till another calculus evidently began to be formed in the kidney.

A great many symptoms closely resembling the above, and even accompanied by the *pretended* evacuation of gravel or concretions, are met with in hysterical females. I allude to the subject here, with the view of drawing attention to it; some further details will be given in a subsequent chapter on vesical diseases.

The previous history of the patient, and the condition of the urine, will in a great many cases throw more light on their nature, than any of the other circumstances. But when from all these, and from the other symptoms, it is impossible to come to any certain conclusion respecting the presence or absence of calculus in the kidney; the facts should always be borne in mind,—that such symptoms *may* indicate the presence of a calculus in that organ; or at any rate, that they render the *future* formation of a calculus in that organ very probable. Hence the attention should be particularly directed to these points; and the constitutional derangements, as well as the derangements of the urinary secretion, should be corrected as far as possible, according to the principles laid down in the preceding and subsequent pages, so as to prevent the formation of a calculus; or if a calculus be already formed, to prevent its increase in magnitude.

Treatment.—We shall now make a few remarks on the general principles of the treatment of the heterogeneous class of diseases briefly noticed in the present chapter. In acute inflammation of the kidney, in young and vigorous subjects, copious and sometimes repeated abstractions of blood, both from the arm, and locally by cupping or leeches, are necessary; but in milder cases,

the back and loins sometimes prove. I have seen for instance, the whole pain and uneasiness referred to the side *opposite* to that in which the disease lay; and have actually known more than once, a seton applied over the sound kidney. Again, the spinal and psoas diseases sometimes creep on so imperceptibly, and are so mixed up with the urinary symptoms, that they have been entirely overlooked, not only by others, but by myself. These incidents are mentioned with the view of showing the propriety of the caution in diagnosis and prognosis alluded to in the text.

and in *pyelitis*, for instance, general bloodletting is seldom requisite ; though cupping to a certain extent may be useful. These means should be immediately followed by the use of the warm bath, and by the exhibition of active doses of calomel, conjoined with opium, henbane, colchicum, &c., according to the severity and nature of the symptoms. When by these or other means, the irritation of the stomach usually present has subsided, and will permit, diuretic purgatives may be administered ; of which, in gouty individuals more especially, the *vinum colchici*, or some other preparation of this drug, should form a constituent part. In gouty subjects, also, warm mustard cataplasms may be applied to the feet. Some object to the use of blisters in this disease, and in the earlier stages they are useless at least, and may do harm ; but when the disease has begun to yield under the more active treatment above recommended, the judicious application of blisters is not only safe, but beneficial. Large emollient clysters also, with or without opium according to circumstances, are sometimes particularly useful in the decline and less active stages of nephritis. Throughout the attack the strictest anti-phlogistic regimen is to be adopted ; and when the functions of the kidneys have begun to return, warm emollient drinks, as linseed tea, barley or gum water, &c., may be taken plentifully, and with advantage.

When there is obviously a calculus in the kidney, and the circumstances warrant a trial of the means formerly mentioned for its expulsion, these may be cautiously resorted to. But when from the length of time the disease has existed, or from other circumstances, its expulsion appears hopeless, and the affection has assumed a chronic form, recourse can be only had to preventives and palliatives. Thus if in the kidney, we may still hope to prevent the future enlargement of the calculus by attention to the circumstances already pointed out for obviating the different calculous diatheses ; while, to prevent the chronic inflammation too easily induced under such circumstances, the introduction of a seton or issue near the part affected, is often attended by the best effects. When the chronic inflammatory action is accompanied by *pyelitis*, small doses of balsamic remedies, or of the *infusum diosmæ*, are often particularly useful.

In cases of chronic suppuration and abscess of the kidney,

when inflammation is absent, and the nature of the disease is evident by the purulent condition of the urine, &c.; in addition to the other means, and with the view of alleviating the pain, anodynes, either internally, or in the form of suppository or ointment, may be had recourse to. If gouty irritation be supposed to be present, the anodynes may be often combined with small doses of the acetous extract of colchicum, to the great relief of the patient. In these complaints, also, the *uva ursi* is sometimes of great benefit. It may be given in the form of infusion, decoction, or extract, according to circumstances. Some have also recommended the use of small doses of copaiba and other balsamic remedies, but their effects must be watched; and they are less safe as well as less beneficial, according to my observations, than the *infusum diosmæ*, the mildest perhaps of the remedies referable to this class.

In all renal affections of a chronic character, the *acidity* and *alkalescence* of the urine should be particularly attended to; as neglect on this point often leads to unpleasant consequences, and to the decided aggravation of the disease. We shall content ourselves, however, with barely mentioning the circumstance here; as this subject, together with the general subject of *mineral waters*, will more particularly occupy our attention in the subsequent chapters.

When the affection of the kidney is supposed to be of a scrofulous character, the same general principles of treatment are to be kept in view; but in conjunction with them, the tonic and restorative plan usually adopted in that form of cachexia may be applied as far as circumstances will permit. In particular, some of the milder preparations of iron combined with warm sea-bathing may in general be employed with considerable advantage.

Lastly, the diet should be light and easy of digestion, and free from all stimulating condiments. In some instances, a milk diet has been found beneficial. Hard waters never fail to increase the uneasiness and pain in the back, and hence should be particularly avoided. The subject of mineral waters we have already postponed till we come to speak of bladder affections in a subsequent chapter. It may, however, be observed here, that many of the milder effervescing alkaline and chalybeate waters, as the

Seltzer, Pyrmont, &c., are often highly beneficial in various chronic renal affections, when properly directed.

With respect to the other affections of the kidney above alluded to, viz. cancerous disorganization, hydatids, &c., even if the evidence of their existence be unequivocal, which is not always the case, no specific plan of treatment can be recommended. In such unfortunate cases, the general principles above mentioned must be kept in view, so as to do no mischief if we can do no good. Symptoms as they arise must be combated by the palliatives best suited to the case; and opiates in particular, especially the preparations of Morphia, must be so administered as to alleviate as much as possible the patient's sufferings, and preserve the general health unimpaired.

CHAPTER III.

OF THE ORIGIN AND INCREASE OF CALCULI IN THE BLADDER;
AND OF THE SYMPTOMS AND TREATMENT OF VESICAL CONCRE-
TIONS IN GENERAL.

A very large proportion of the symptoms connected with concretions in the bladder, as well as with diseases of the prostate gland and bladder in general, fall within the province of the surgeon. With his duties it is not my intention to interfere; but, in this and the following chapter, shall content myself with relating, in as concise a manner as possible, the leading symptoms produced by the presence of concretions in the bladder; and by the most common organic diseases of the bladder and prostate; chiefly with the view in the first place, of pointing out the diagnostic relations or differences between them; and secondly, with reference to the general principles of treatment, according to the views attempted to be established in the former part of this volume.

The formation of a stone in the bladder without the intervention of a foreign nucleus, is comparatively of rare occurrence. Indeed, it may be doubted whether lithic acid and oxalate of lime concretions are ever formed in the bladder; for how much soever these principles may abound in the urine, they are generally retained in solution till the urine is voided. The case is different with phosphatic and perhaps with cystic oxide calculi; which may be, and occasionally are, formed on nuclei of their own substance, deposited in the bladder itself.

The most frequent origin of vesical calculi, as before stated, is the retention of a renal calculus in the bladder; where it constitutes a nucleus, around which a further concretion of calculous matters takes place. Sometimes, though much more rarely, the nucleus consists of a clot of blood or mucus; sometimes of a foreign substance introduced into the bladder, &c.

The future increase of vesical concretions, like their origin, is well understood. That is, the increase of vesical concretions can happen only by the gradual precipitation of that excess of the principles composing them, which is incapable of being retained in solution in the urine. There are, however, some trifling variations in the modes in which the precipitation of calculous matter takes place from the urine, in the different forms of calculi; which will be briefly mentioned after we have considered the general nature of the supersaturated condition of the urine alluded to.

Saturation in a saline solution of a constant temperature may be defined to be the point at which a solvent, in contact with a salt, can neither take up any more, nor deposit any more of that salt. Hence every saline solution which deposits a salt without any change of temperature, obviously contains more of that salt than is necessary to saturate it; or such a solution is said to be *supersaturated*.

The point of supersaturation is unfixed, and depends on many extraneous causes; but the point of saturation, although for the most part it varies with the temperature, is supposed to be as fixed and constant at any given temperature, as the points at which water freezes or boils. Hence when the solution of a salt is supersaturated, the excess is always sooner or later deposited; and the solution arrives at the point of saturation.*

* M. Gay Lassac, Ann. de Chimie et de Physique, xi. 296. Annals of Philosophy, xv. 1. Such is a simple and probably a correct exposition of the law of saturation and its consequences. But this law is apparently liable to be modified in many instances, by particular forms of aggregation; and by the properties which many bodies possess of combining with water, or of forming *hydrates*. Thus in the hydrated condition, lithic acid is comparatively soluble in the water and in the urine; but such is the aggregating force exerted by the molecules of pure lithic acid towards one another, that

Let us apply these remarks to the subject in question. A calculus in the kidney or bladder may be considered as a substance placed in a solution of various principles in a certain quantity of water. If any of the more insoluble of these principles exist in this solution in a state of *supersaturation*, the calculus will afford a nucleus around which the *excess* will be deposited. But if no salt exists in excess, of course none can be deposited, and the calculus will not increase in bulk.

Such is the general nature of the increase of urinary calculi both in the kidney and bladder; but a great deal of additional light is thrown on this subject, by a careful attention to the structure of urinary concretions. Thus some of them, as we shall show hereafter, have a crystallised structure, indicating purity. Others exhibit an amorphous or earthy fracture when broken, indicating for the most part impurity or mixture. In almost all cases, however, the general structure of urinary calculi is *laminated*: indicating, as we shall attempt to show, that their formation has been interrupted, or has taken place at different intervals. This is particularly the case with calculi composed of lithic acid, which constitutes the most frequent species.

If calculi were *constantly* increasing, even though the rate of deposition might be variable, their texture ought to be homogeneous, or at least *not* laminated; for as their increase under such circumstances, though it might be a little faster or slower, would never *cease entirely*, the law of continuity, on which homogeneity of structure depends, would not be broken. The laminated structure of calculi, therefore, distinctly shows that the law of continuity, as regards their formation, has been broken: in other words, that the different laminae have been formed at different intervals; between which intervals, periods have intervened when no deposition has taken place. This remark not

these molecules detrude the combined water, and unite together in preference, in the solid or crystallised form. Hence water containing newly precipitated and hydrated lithic acid, retains for a considerable time a much larger quantity of this principle in solution, than water can be made to dissolve by mere digestion, or even by boiling. Remarks somewhat similar might be made respecting most of the other ingredients of which calculi consists.

only applies to the different laminæ of calculi composed of the same substance ; as, for instance, to the different laminæ of which lithic acid concretions usually consist ; the explanation is in perfect accordance with the circumstances attending the formation of calculi, which often, as is well known, remain in the bladder for a great number of years, without attaining any remarkable size. Moreover, the constant state of change alone to which the urine in all individuals is liable, almost precludes the notion of homogeneity in a calculus. We may suppose, therefore, that certain changes take place in the urine, during which the law of continuity of deposition is suspended, and the surface of the concretion becomes, as it were, *water worn*, and less apt to future accretion ;—in short, assumes all the properties of a heterogeneous substance. Under these circumstances, when a tendency to deposition recurs, it will have to commence *de novo*, and, as it were, upon the surface of a foreign body. The consequence will be, that the adhesion between the new and old coats or laminæ will be less firm than in the intermediate parts ; and that a calculus thus formed, will be disposed when broken to separate into concentric laminæ.

Some other curious and important changes which urinary calculi appear to undergo during their continuance in the bladder, from changes induced in the urine, and from other causes, will be deferred till a future chapter ; when we come to consider the subject of their removal from that organ.

Symptoms of Calculus in the Bladder.—The symptoms produced by concretions in the bladder cannot be thoroughly understood without a competent knowledge of the constitutional symptoms attendant on the different calculous diathesies. This knowledge, therefore, we shall take for granted the reader possesses, and proceed at once to our object.

The leading symptoms produced by urinary concretions in the bladder, may be considered under the heads of—pain and irritation in the bladder itself, either alone or accompanied by sympathetic pains in contiguous or remote organs ; and the presence of blood, or of some other morbid derangement, in the urine.

The degree of pain and irritation in the bladder occasioned by the presence of concretions in that organ, other things being equal, usually varies, in the first place, according to the size and

other circumstances incidental to the stone itself ; and secondly, according to the prevalent diathesis.

When a small concretion of any kind descends from the kidney into the bladder, the great and immediate relief which follows is apt to cause its retention in the bladder to be overlooked : and any little uneasiness that may be occasioned by it, is considered by the patient as the mere consequence of the preceding attack, that will subside after a while, like the rest of the symptoms. Indeed the degree of irritation produced by small lithic acid concretions, in the greater number of instances, is so trifling, that if it attracts the patient's attention at all, it rarely alarms him. The irritation, if any, for it cannot be called pain, is indicated by a peculiar sensation at the end of the penis. This irritation is more especially felt just as the bladder is emptied, and assumes various forms in different instances. Sometimes it is described as a sense of titillation or itching ; at other times, as a dull sensation of weight or numbness ; at other times, as a slight scalding, as if a drop or two of urine was left behind in the urethra, &c. These symptoms, which are generally accompanied by a more frequent desire to pass water than natural, usually come on just as the bladder has been emptied ; occasionally, however, (particularly after exercise, or if the patient be standing,) they are suddenly felt during the act of passing water ; and the stream at the same time becomes broken or obstructed. When this latter occurrence takes place, there can be little doubt about the presence of a small concretion in the bladder, to which the mechanical obstruction of the urine can alone be referred. Moreover, in a very large majority of instances, it will be found both from the patient's previous history, as well as from the properties of the urine, that under the above circumstances, the concretion consists of the lithic acid. When the preceding symptoms are accompanied by a sharp pricking sensation about the neck of the bladder, as well as at the point of the penis, the small concretion will be probably of the mulberry variety. This circumstance, however, is not to be considered as absolutely characteristic ; but if the history of the patient and the properties of the urine coincide in favour of the same view, the probability will be almost converted into a certainty. I am not aware of any modification in the above symptoms produced by the presence of small cystic

oxide or phosphatic calculi in the bladder, except, perhaps, occasionally in the degree of their severity.* The nature of the concretion, therefore, must be inferred from other symptoms, and particularly from the properties of the urine; which are commonly so characteristic as to leave little doubt on the subject.

These observations are more especially applicable to the presence of concretions in the bladder of such a small size that there is every probability of their coming away, either spontaneously, or by the aid of appropriate medicines, without any mechanical assistance. The presence of such small concretions in the bladder is seldom accompanied by the other characteristic symptoms mentioned, viz., by sympathetic pains in contiguous or remote organs, or by a bloody state of the urine—symptoms, therefore, which when present, usually denote that the concretions have become too large to pass away spontaneously; and that the confirmed state of the disease, to be in next place considered, is fairly established.

When a calculus exists in the bladder too large to pass off spontaneously, the preceding symptoms or pain or irritation become gradually more and more decided. The desire to pass urine is, in the first place, more frequently felt, and is often urgent; particularly after change of position or under exercise. The sensation or pain at the end of the penis, after emptying the bladder, is more severe and continues longer. Frequently, also, a feeling of weight about the perineum, and a sympathetic uneasiness, allied to tenesmus, about the rectum, accompany the sensation at the end of the penis. As the stone increases in magnitude, the whole of these symptoms gradually become more and more urgent, and at length assume their most distressing forms. At the same time, the patient's health, which had been hitherto but little affected, now begins to suffer; and the last stage of the disease, to be presently described, becomes established.

During the above incipient and earlier stages of the disease the urine undergoes various changes; but on the whole acquires a

* In the brief history of the cystic oxide diathesis given in the first book, I omitted to notice an instance of a concretion of this substance about the size of a filbert, removed by lithotomy in 1841, from a delicate boy of four years old, who recovered favourably from the operation. In this, as in other instances, the urine contained the cystic oxide in solution. See page 235.

more unnatural appearance as the calculus becomes larger; so as to form a tolerable index of the progress of the affection. The first circumstance which usually strikes our notice, is the general absence from the urine, in the solid form at least, of the materials of which urinary calculi usually consist. Thus if the patient had for years before been in the habit of passing lithic acid gravel, it will be generally found that when a calculus exists in the bladder, this deposit disappears from the urine. At the same time it may be noticed, particularly after exercise, that an increased deposition of mucus takes place. This mucus is at first diffused through the urine, and renders that secretion more or less opalescent; but after a time it begins to collect into rusty coloured floccules, which subside to the bottom of the vessel. This mucus contains involved in it, a considerable quantity of the yellow colouring matter of the urine, as well as of lithic acid; and one of its characteristic features is, that it rarely adheres together in tenacious masses, like the mucus from the bladder in its more excited or inflamed condition. I do not know that the above description will convey to the inexperienced reader a sufficient idea of the circumstance in question, so as to enable him to distinguish it; but rightly understood, I regard this appearance as one of the earliest, as well as one of the most striking and unequivocal indications that I am acquainted with, of the presence of a small or moderately sized lithic acid concretion in the bladder. The presence of a mulberry concretion in the bladder is often accompanied by an excess of mucus in the urine; but the mucus, instead of assuming the yellow rusty tint above mentioned, is often nearly transparent and of a greenish colour. The lithate of ammonia, also, which from a slight cold, or other cause, occasionally makes its appearance in the urine in the oxalic acid diathesis, assumes, instead of a red or yellow, a bright pink, or dirty ash colour. In the few instances of vesical calculi composed of the cystie oxide, which have fallen under my observation, the urine has always contained this principle. So also when the concretions consist (even externally) of the phosphates, the urine is always alkalescent, and abounds in ropy mucus, enveloping more or less of the earthy salts. In all these cases, the urine frequently contains blood, as well as other unnatural ingredients, particularly after exercise; and this appearance of blood is generally (not always) accompanied by an in-

crease of pain or irritation about the bladder. The worst cases of haemorrhage I have seen, have happened to plethoric individuals labouring under the lithic acid diathesis, and in whom the abdominal viscera seemed to be particularly congested : and in a few of such cases I have noticed periodic haemorrhage to recur every few weeks, whether exercise was taken or not. Considerable haemorrhage also is occasionally produced by oxalate of lime concretions, particularly when haemorrhoidal congestion is present ; which is not very uncommon in this diathesis. In such cases the blood is usually dark coloured. Were I to give an opinion from the little I have seen of cystic oxide concretions, I should say, haemorrhage is not of common occurrence in this diathesis. The same is also the case with respect to phosphatic calculi ; for though the urine and the mucus it contains are often tinged with blood, when phosphatic calculi exist in the bladder ; yet, according to my observations, decided haemorrhage from this form of concretion is comparatively rare—a circumstance probably arising, in part at least, not only from the absence of abdominal congestion, but from the incapacity of the patient, under these circumstances, to take the necessary exercise.

The length of time during which the above symptoms may continue in a moderate form, particularly when the concretions consist of the lithic acid, is in some instances surprising. I occasionally see two gentlemen, the one of whom twenty-five, and the other at least ten years ago, obviously laboured under all the symptoms of lithic acid concretions in the bladder ; and who still go on, suffering very little inconvenience from their presence in that organ, except occasional slight irritation and haemorrhage after exercise. Both these individuals, during the whole of the long periods mentioned, have rigidly adhered to the prophylactic regimen, &c., prescribed for them ; and there is every reason to believe, with so much success, that the calculi have been very little augmented in size. In these and similar instances, it is probable that the calculi in some way become fixed, either behind the prostate, or in a fold or cyst of the bladder ;* for I have seen repeated

* Some have maintained that calculi *adhere* to the bladder, but this is a very rare occurrence ; and is principally confined to phosphatic concretions.

instances, in which under these circumstances all the miseries of stone in their worst form have been suddenly induced by a severe jerk or fall; or by the introduction of the finger into the rectum—accidents which have probably dislocated the stone, and rendered it free in the bladder.*

This immunity from suffering may happen with all the varieties of calculus. In one of the cases referred to in the note, the calculus I believe was of the phosphatic kind; but this is probably a rare occurrence; and most of the instances of quiescent calculi, that have fallen under my observation have been of the lithic acid variety. Next to lithic acid concretions, perhaps the mulberry varieties are capable of being longest retained in the bladder; notwithstanding their roughness. This is inferred from the size such calculi often assume, as well as from their purity. In such cases it is probable that the concretion may be fixed; and that the oxalic acid is principally formed during the primary assimilating processes. For, as already noticed, in the oxalic acid diathesis, the general health is often but little involved when the primary digestive organs or the skin are more especially affected.

Another peculiarity almost confined to the lithic acid form of concretion, is the *number* in which they occasionally exist in the bladder. Patients in advanced life, who are in the habit of passing the pisiform variety of lithic renal calculi, are, from this cause liable to have a plurality of concretions in the bladder; and in some of these cases forty or fifty or more concretions of all sizes, from that of a pin's head to that of a nutmeg, are contained in the bladder at the same time. In such cases, the larger concretions have usually a polygonal form, arising from their contact or attrition with each other. A plurality of mulberry concretions in the bladder is rare. Of a plurality of cystic oxide concretions I cannot speak. Nor have I seen more than two or three large concretions of the phosphates in the bladder at the same time; though the presence in that organ

* In some instances, the direct counterpart of this accident takes place, and an individual who has for years laboured under all the symptoms of stone, suddenly ceases to be troubled for a time; or even for the whole of his life afterwards. Sir B. Brodie gives instances of this kind. See *Lectures on the Urinary Organs*, pp. 258 and 293, third edition.

of small irregular fragments, consisting of the phosphates, in an imperfectly crystallised form, or in a plastic mortary state, are very common.

It remains to make a few remarks on the third and last stage of suffering induced by the presence of calculi in the bladder. When a calculus of considerable magnitude exists loosely in the bladder, and when, from any unfortunate combination of circumstances, the general health as well as the bladder have become impaired and susceptible, all the distressing symptoms above mentioned, become aggravated and assume their worst form. The stone by its weight naturally gravitates to the sensitive and irritable neck of the bladder, where it produces constant pain and desire to pass the urine; and at the same time, by obstructing the passage, deprives the unfortunate sufferer of the power of relieving himself; at least in the vertical position.* Hence he naturally throws himself into some other attitude; and in extreme cases, patients under those circumstances have been known, with the view of removing the weight and obstruction about the neck of the bladder, to pass their urine with their head downwards. The patient, however, seeks in vain for relief, by passing his urine. On the contrary, all his sufferings are augmented by the act; for the moment the irritable bladder is emptied, it spasmodically grasps the stone, and the most acute sympathetic pains dart to the rectum, down the thighs, and even to the bottom of the feet. All these pains, however, are tolerable, compared with the agony experienced in the *glans penis*, which the patient squeezes violently to mitigate his sufferings—an act instinctively imitated by children, who thus tell by their actions what they want words to describe. Exercise is now rendered intolerable; rest impossible. Under these circumstances, further inroads are daily made in the general health; large quantities of bloody mucus appear in the urine; and the diathesis, whatever it was before, decidedly

* Sir B. Brodie has well observed, that when the prostate is enlarged, the tumour prevents the stone from falling down to the neck of the bladder, and thus not only obviates the mechanical stoppage of the urine, but also the contact of the foreign body with the most irritable part of the bladder. Hence individuals with an enlarged prostate, instead of suffering more, often suffer less than other individuals. *Lectures on the Urinary Organs*, p. 265, third edition.

changes to the phosphatic. Finally, the coats of the bladder become diseased and thickened ; the mucus gradually gives way to pus ; every bad symptom begins to assume its most aggravated form ; till at length, sometimes after a short calm, welcome death closes the scene of misery.

For reasons already alluded to, and which need not be more fully explained here, calculi are much more rare in women than in men.* Calculi in the female bladder produce symptoms analogous to the above ; that is, there is a frequent desire to pass water ; there is pain, particularly after passing water, referred to the extremity of the urethra ; the urine is liable to be tinged with blood after exercise ; and as the disease proceeds, the diathesis, whatever it was originally, finally assumes "the phosphatic form.

After what has been stated, we need not dwell on the diagnosis or prognosis in calculous affections. The subject of prognosis in particular, will be much more properly considered when we come to speak of the means of removing calculi from the bladder. It remains, therefore, only to make a few remarks on the medical treatment of calculi.

Treatment. — The treatment of urinary calculi, in the light we are now considering the subject, may be said to consist of two indications, viz. the removal of small concretions from the bladder, as fast as they are deposited in that organ ; and the mitigation of the sufferings of the patient in those cases in which the stone cannot be safely removed by surgical, or by other expedients.

As a general rule it may be remarked, that whatever passes down the ureter, can pass through the urethra. The moment, therefore, it is ascertained that a small concretion has entered the bladder, no time should be lost, nor no means spared, to remove it as quickly as possible—a rule, which if it were uniformly attended to, would probably prevent altogether the formation of vesical calculi.

When a small concretion enters the bladder from the ureter,

* Sir B. Brodie informs us that the proportion of females to males who have suffered from calculi in the bladder, according to his own observation, has been about one to fifteen or twenty. *Lectures on the Urinary Organs.* p. 273.

it is often retained for a few days, even under the most favourable circumstances, till the excitement occasioned by the nephritic attack has somewhat subsided. If it does not then come away, the following principles of treatment, properly directed, seldom fail of removing it from the bladder. The principles of treatment alluded to are very simple, and consist in nothing more than attempting to allay, by antispasmodics, that irritable state of the sphincter of the bladder, which often exists under these circumstances, and prevents the calculus from entering the urethra; and afterwards, or rather at the same time, to favour the expulsion of the calculus by the exhibition of simple diuretics, or diuretic purgatives, with the view of increasing the flow of urine. When the calculus consists of the lithic acid, diuretic purgatives containing the Rochelle salts, and colchicum or henbane, or a mixture of the two sedatives, are perhaps, in conjunction with the free use of diluents, the most efficient means we can employ. The diluents may consist of barley water, linseed tea, &c., assisted by the common soda or potash water, or even plain distilled water; to which may be added small quantities of the *spiritus aetheris nitrici*, or the *spiritus juniperi comp.* When the concretion consists of the oxalate of lime, henbane or opium may be employed as before, to allay irritation; but I have found a very dilute solution of the nitro-muriatic acid in distilled water, the best diuretic diluent in this case. Concretions formed of the phosphates usually require the decided use of sedatives; and the best diluents are either simple acrated water, e. g. the soda water of commerce; or a very dilute solution of the nitro-muriatic acid, lemon juice, or the *spiritus aetheris nitrici*.

In conjunction with the above expedients, the patient should be instructed when he passes his water to lean forward, so as to favour the escape of the concretion. He may be also directed to distend the urethra with urine, by grasping the penis; and then, by suddenly removing the obstruction, to let the water flow off in a prone position. Should these expedients fail, the urethra may be cautiously expanded by bougies; and when this has been accomplished, the bladder may be emptied as the bougie is withdrawn; the patient at the same time favouring the exit of the calculus, as before, by leaning forward. Under these circumstances, the calculus will sometimes follow the bougie, and enter-

ing the urethra, make its escape.* Small concretions are apt to make their escape in the water-closet, and to be thus lost. The patient, therefore, should be either directed to empty his bladder before sitting down ; or so to apply a muslin strainer as to retain anything solid that may pass from the bladder. I dwell on these points, because it is always of the utmost importance to get ocular evidence of the escape of the concretion.

The next point to be considered, is the treatment of those cases, in which from any cause it may not be desirable to attempt the removal of a calculus from the bladder. Such cases, since the practice of lithotripsy, may be said to be much more rare than formerly ; for there are very few instances, in which small or moderately sized concretions, particularly of the lithic acid variety, may not at once be crushed and removed. When from any cause it may not be deemed advisable to attempt the removal of calculi from the bladder, and when the symptoms are moderate, our attention should be chiefly directed, in the first place, to restore the natural condition of the urine, so as to prevent the increase of the concretions ; and in the second place, when nothing else can be done, to alleviate, as far as we are able, the sufferings of the unfortunate patient.

With respect to the first of these points, the treatment will depend on the nature of the calculus ; a point which in general can be determined with tolerable certainty by means of the phenomena detailed in the preceding pages. When the calculus obviously consists of the lithic acid, we must commence by reducing, as far as we are able, by the use of alteratives, colchicum, and purgatives, that congested state of the abdominal viscera, which usually accompanies the formation of this species of concretion ; and in the next place, must not only lay down such a system of diet and regimen, as shall prevent congestion for the future ; but, at the same time, attempt so to influence the properties of the urine, by the judicious use of alkaline remedies, as to counteract, without impairing the functions of the stomach, the further deposition of lithic acid. The means by which these indications are to be best fulfilled have been already explained, and need not be repeated.

Similar remarks may be made with respect to the treatment of

* Sir B. Brodie's Lectures, page 282.

the other forms of calculous affections; it only remains, therefore, in the last place, to consider the second general point of treatment above alluded to, viz. the means best calculated to relieve the patient's sufferings, when, in the last stages of the disease, we can hope to do nothing more.

We have already stated that the last stages of calculous affections are almost always accompanied by disease of the bladder, an alkaline condition of the urine, and by the deposition of the phosphates. These circumstances should be constantly borne in mind with the view of preventing the exhibition of improper remedies; and thus of doing evil, when we cannot reasonably hope to do good. At the same time, sedatives, which are the chief means of relief we possess, should be associated, as far as possible, with those means which have a tendency to improve the properties of the urine, or to arrest the formidable disease of the bladder. Thus the use of opiates (of which, perhaps, the muriate of morphia conjoined with hemlock or henbane is one of the most efficient) may be given with the decoction or infusion of the *Lythrum*, *Pareira brava*, *diosma*, or *alchemilla*, all of which may be acidulated or not, according to circumstances. Should the muriate or acetate of morphia disagree, Battley's sedative solution, the black drop, the meconiate of morphia, &c., may be substituted. Sometimes sedatives agree best when conjoined with a small quantity of some alkali, as magnesia or soda; and in such cases the alkalies not only counteract that acidity of the stomach frequently produced by opiates, but help to prevent their constipating effects on the bowels. The constipating effects of opiates are principally occasioned by deranging the balance between secretion and absorption; and may be ranked among their most troublesome consequences. Constipation must be obviated in the best manner we are able. Castor oil is an appropriate purgative in such cases; but when this cannot be borne, various purgative pills, of which the compound extract of colocynth and scammony may form constituents, must be resorted to. Sometimes laxative injections suit best; but much depends upon whether the fluid of which they consist, is all returned. When opiates are largely given at the same time with laxative injections, they are too apt to be retained in the bowels; in which case their watery contents are rapidly absorbed and pass off by the kidneys,

and thus for a time very much increase the patient's sufferings. If opiates taken internally disagree, opiate injections or suppositories may be had recourse to. This local use of opium sometimes gives great relief; and may be either trusted to alone, or given over and above the ordinary internal doses. The use of such expedients is particularly beneficial at night, when the object is to procure sleep, as well as freedom from pain. In conjunction with opiates, the warm bath, warm fomentations, the sitting over the vapour of warm water, and all the other well known and analogous expedients, may be had recourse to. These and every other means we can employ will too often fail; but it is well in desperate cases to have a variety of resources; and sometimes it will be found that a trifling and improbable expedient will for a time bring unexpected relief. Large warm poultices sprinkled with laudanum, and applied to the perineum, occasionally relieve the severe local sufferings. In acute paroxysms also I have seen great temporary relief produced by a lotion composed of the *liquor plumbi acetatis dilutus* and tincture of opium, applied as hot as possible, by means of sponge, linen cloths, &c., to the perineum.

CHAPTER IV.

OF DISEASES OF THE BLADDER AND ITS APPENDAGES, PRODUCED BY, AND LIABLE TO BE CONFOUNDED OR COMPLICATED WITH, VESICAL CALCULI.

THE diseases to be chiefly considered in this chapter may be included under two general heads or sections, viz. 1. Diseases connected with *inflammation* of the bladder or its appendages, or resulting from such inflammation; and 2. Diseases of an *irritable* character, connected either with certain *organic* and *mechanical* diseases of the kidneys and bladder; or with affections of these organs of a purely *functional* or *nervous* character. These two sections of diseases gradually pass into each other, so that it becomes impossible to define the exact limits between them. Moreover, they may all arise from, or at least may be complicated with, stone in the bladder, from which in many cases it is difficult to distinguish them; and finally, most of them require surgical aid, and therefore do not entirely fall within our present design. On the surgeon's province we shall not infringe; but confine our observations chiefly to the general pathology, diagnosis, and medical treatment of these affections.

1. *Of Cystitis or Inflammation of the Bladder.*—Inflammation of the bladder, like that of most other parts, is usually divided into the acute and chronic. In general, chronic inflammation in organs, is the result or consequence of acute inflammation; but in inflammation of the bladder, the chronic form of the

by motion or pressure, and often extends to the rectum and anus, and down the thighs. The bladder now begins to be denuded of its mucous membrane; or formidable ulceration takes place. The desire to make water is more frequent than ever; and though the urine is occasionally passed with less mechanical impediment, owing to the changes which have taken place in the character of the mucus, &c., yet little is gained in point of improvement by the change. Under these circumstances, the general health of the patient rapidly gives way; the countenance becomes pale and anxious; the pulse quick and powerless; the appetite fails; he loses altogether the capacity for exercise; and if not cut off by the disorganization of the kidneys and bladder occasioned by the disease, which is its most usual termination; the patient at length dies, sometimes after a short interval of comparative freedom from pain, quite exhausted.

In the second stage of the disease, the urine undergoes corresponding and very instructive changes. The quantity of the mucus (in its ropy form at least) is perceptibly diminished; the mucus also becomes opalescent, and of a greenish tint, and is not only less tenacious, but can in part be easily diffused through the urine, rendering it glairy, or opaque and milky, like pus; in short, the urine becomes muco-purulent; *i. e.* the mucus gives way to pus, (or to something not yet sufficiently distinguished from pus, to deserve a distinct appellation,) till at length all the characters of mucus, except perhaps a few shred-like matters, disappear. The urine now is generally deep coloured, or like the washings of flesh; serous and alkalescent. When alkalescent, it has generally a strong ammoniacal smell, and effervesces with an acid; and in this case there is almost always an excess of the carbonate of potash or of soda present; which are derived from the serum of the blood exuded from the ulcerated inner surface of the bladder.* When these symptoms have continued for a greater or less period, the urine becomes scanty, still more high-coloured, and occasionally even acid; the mucus and even the pus gradually diminish or almost disappear; and as

above mentioned, after a short period of comparative ease, the patient expires.*

Authors speak of inflammation, both acute and chronic, of the *muscular* structure of the bladder. We also read of *rheumatic* and *gouty* inflammation of this organ. I have been informed that rheumatic or neuralgic affections of the bladder are well known, and not unfrequent, in malarious districts bordering on the tropics; and I believe that I have seen a few instances of such affections in this country. In such cases it is probable that the muscular and nervous structures, and their appendages, are the chief seat of the affection. With respect to the existence of gouty inflammation of the bladder, I believe there cannot be two opinions; and if we take the matter for granted, we must suppose that such inflammation attacks in preference that peculiar structure of the bladder, which is analogous to, or identical with, the structure attacked by gouty inflammation in other parts of the body. Whether the

* I have repeatedly seen the urine become acid in the last stages of all kinds of bladder disease, and have, in consequence, foretold the speedy death of the patient. Indeed I do not remember to have seen a person recover, when the urine has rather suddenly become acid, in long protracted and severe affections of the bladder usually accompanied by alkaline urine. After death, the urine, though alkaline in the bladder, is often found acid in the kidney; provided that organ be not diseased.

Mr. Coulson, in the second edition of his work on Diseases of the Bladder, describes a disease which he terms, "Acute Inflammation of the Mucous Membrane of the Bladder." I am not sure if I am acquainted with any disease of an idiopathic character deserving this appellation. The nearest approach to it I have seen, has been the last stages of cystirrhœa described in the text; or the last stages of some other previous and long-existing disease in which the kidney had been generally involved. In such cases, the unnatural, strumous, or malignant characters of the diseased secretion from the kidney, seem to have induced a similar train of diseased action, and ulceration in the bladder; to which organ the whole of the patient's sufferings have been in a great measure confined. And it is remarkable that in many of these cases, the mucous membrane of the bladder (instead of having its *natural function of secreting mucus increased* as in cystirrhœa) is *entirely destroyed*, so that the urine at no time is loaded with mucus, as in cystirrhœa; which is not only, therefore, a totally different affection, but, however severe it may be, is of a much less formidable nature. Moreover, though cystirrhœa usually terminates in diseased kidney, it seldom commences, or is necessarily connected with such affection; like the disease in general above alluded to.—Op. cit. page 80, third edition.

mucous membrane be the structure primarily attacked by gouty inflammation, I do not know; I believe it is not; but that like the skin in other parts of the body, the mucous membrane (as in cystorrhœa for instance) is only secondarily affected. So far I am willing to allow, that inflammatory excitement, or something which we must denominate inflammatory excitement, may chiefly be confined to the muscular and nearly allied structures of the bladder. I can also understand how ordinary inflammation may involve these structures in common with the rest of the structures of the bladder; but I confess that at present I am quite unacquainted with, and indeed doubt the existence of, the commencement, and particularly the limitation of ordinary inflammation to the muscular structure of this organ. These subjects will be again alluded to, when we speak of painful and spasmodic affections of the bladder.

Of general Inflammation of the Bladder.—The form of inflammation we are now considering, may commence in any of the structures of the bladder; but in whatever structure it may commence, it ultimately involves all parts; and particularly the *cellular substratum* of the organ, which perhaps may be considered as its characteristic feature. The commencement of the attack varies somewhat, according to the part in which it originates. If inflammation commences in the mucous membrane of the bladder; the earlier symptoms are those of cystorrhœa above mentioned. If in the muscular and nervous tissues, which is probably very rarely the case, the symptoms may resemble those of rheumatism or gout, before alluded to. If it commences in the peritoneal coat of the bladder, which it is sometimes said to do, the symptoms are those of local peritonitis, which are too well known to require recital here; lastly, if general inflammation of the bladder originates, as it most frequently does, in ulceration, wounds, or injuries of the bladder, prostate, or urethra, the earlier symptoms will vary accordingly; and though in this case they are totally different from all the earlier symptoms above mentioned, yet such is their obvious nature that they can be hardly mistaken, and they therefore do not require recital. Up to this point then, the initial and earlier symptoms attending general inflammation of the bladder may be very different; but when once general inflammation becomes established, the future course of the

affection is nearly uniform; and all the minor distinctions are lost or absorbed in the overwhelming destruction that too frequently ensues.

General inflammation of the bladder almost always commences with rigor. This rigor is occasionally so slight as sometimes to escape notice; while in other instances, particularly when the exciting cause of the disease involves the neck of the bladder and prostate, the rigor is well marked and severe. The rigor is accompanied and followed by malaise, restlessness, nausea, and disinclination to take food. The skin becomes hot and dry, or occasionally partial perspirations take place; and the pulse is increased in frequency. The patient in some instances scarcely complains of pain, at least of more pain than usual; while in other instances, the pain is severe, especially on pressure, and extends to all parts of the abdomen and back, and particularly to the rectum.* Whether there be pain or not, there is always an anxiety of expression and an indescribable something about the patient denoting that deep-seated mischief is to be apprehended. After a time, another rigor, or perhaps a succession of rigors take place, each followed by symptoms more or less resembling those above described, but in an aggravated form. At length all the symptoms become rather suddenly increased; the heat of the skin is greater than ever, the tongue becomes dry, the pulse accelerated to one hundred or upwards, the anxiety and restlessness are most distressing, and there is an occasional hiccough. At this stage (sometimes earlier) the pulse usually begins to intermit, at first occasionally, afterwards more frequently. The abdomen becomes swollen and tympanitic, and the tenderness on pressure increases, particularly over the region of the bladder. As the affection proceeds, all the symptoms become augmented, the pulse is accele-

* The pain, like the symptoms, varies in this stage of the affection according to the chief seat of the inflammatory action. When the inflammation occupies the lower part and neck of the bladder, there is more or less retention of urine; and the pain on introducing the catheter, at the moment it enters the bladder, is severe beyond endurance. Sometimes the inflammation involves the mouth of the ureter; more especially when the symptoms are modified by those of suppression of urine. When the posterior part of the bladder is particularly affected, the rectum becomes involved, and the patient is harassed by a distressing and constant tenesmus.

rated to one hundred and thirty or more, and hourly assumes a more weak and unsteady character. The tongue becomes brown, and sometimes a peculiar state of delirium supervenes, in which the patient perfectly retains his consciousness, but is constantly tossing about and requesting to be removed to some other place. In this state I have known patients suddenly jump up, and even get out of bed and endeavour to make their escape. After such exertions the vital powers usually sink still more rapidly, and the patient expires, occasionally in a state of low delirium, coma, or convulsions; at other times retaining his understanding to the last.* Collaterally with the above symptoms it may be observed, that from the commencement of the affection, the patient usually rejects all food, at least in the solid state; and in the latter stages can be even scarcely prevailed on to swallow fluids. The bowels at the outset of the attack are often confined; but in the latter stages they are sometimes relaxed; or at least a short time before death the patient not unfrequently has one or more calls to empty the bowels. The state of the urine at the commencement presents nothing remarkable, and its quantity is sometimes rather copious. As the affection proceeds, it becomes more scanty, high-coloured, and acid. Frequently it remains transparent, or at least is only slightly clouded by mucus till the last. At other times, it deposits a large quantity of a deep orange red or yellow sediment, consisting of imperfectly developed lithate of ammonia, and is more or less serous; these and other varieties in the appearance of the urine, depend chiefly on the state of the kidneys and mucous membrane of the bladder; and on the immediate exciting cause of the attack. It is remarkable, however, that whatever may have been the nature of the preceding symptoms, or the properties of the urine, it almost always, as before mentioned, becomes acid before death.

It only remains to observe, in conclusion, that a train of symptoms very similar to the above is liable to be induced by causes operating in the vicinity of the bladder, and quite unconnected

* Sir B. Brodie has graphically described this state of inflammation as it occasionally occurs after the operation of Lithotomy. *Lectures on the Urinary Organs*, p. 328, third edition.

with that organ. Thus I have seen them arise after a slight operation about the rectum, &c.* I believe such symptoms take place most readily in those liable to derangements of the saccharine assimilation ; as in diabetic individuals, for instance ; who are notoriously subject to what is called diffuse inflammation of the cellular tissue ; a form of disease nearly allied to, if not identical with, the above. Wounds of any sort, therefore, and particularly surgical operations, are for the most part very dangerous, in such states of the general health.

The appearances found after death, or, in other words, the consequences of these different forms of inflammation of the bladder, are, as already stated, very various. We do not think it necessary to enter into detailed descriptions of them, which will be found in all pathological works on the subject ; but the following sketch may be deemed necessary to complete our inquiry.

The slighter cases of cystorrhœa seldom prove fatal ; so that opportunities rarely occur of examining the bladder in this early state of the disease. The mucous membrane is said to present in general an inflamed appearance ; and to be more or less studded with red spots exhibiting various grades of disorganization. In some of these spots the mucous membrane remains ; in others it is partially disorganized ; while in a few others it is not only entirely destroyed, but ulceration is found to have commenced in the structures below. In more severe cases these appearances are all increased ; and in the last stages particularly, all traces of the mucous membrane are nearly obliterated. In such cases the muscular structure of the bladder is exposed, and its fibres are observed to be enlarged ; while the general texture of the bladder is thickened, contracted, firmer than natural, and corrugated into folds or rugæ ; particularly about the fundus and posterior part of the organ. As Mr. Wilson observes, "the inner membrane of the bladder has not in its natural state many vessels large enough to contain red blood ; but when inflamed, the

* Many of the continental writers assert, that affections of the bladder are very apt to follow operations for haemorrhoids. I have certainly seen affections of the bladder, as well as other serious affections, follow such operations ; but am not prepared to state that the law is general.

trunks enlarge, and the minute vessels are then found to be sufficiently numerous to impart a florid red appearance to the whole surface.* After death, this florid red appearance generally assumes a very dark red or purplish tint; and many of the prominent portions of the bladder are not only observed to be denuded of their mucous membrane, but to be more or less ulcerated. The parts between the prominent muscular columnæ are sometimes expanded into sacs or pouches; which appear to be formed by the protrusion of the lining membrane of the organ between the hypertrophied muscular fibres. When the phosphates abound in the urine, which is often the case in such instances, the sacculi thus formed not only contain phosphatic concretions; but particular spots of the diseased surface of the bladder are sometimes partially incrusted with earthy matters. It generally happens, also, that the above thickened and diseased condition of the bladder is accompanied by unnatural dilatation of the ureters; and a diseased condition of one or both kidneys. In some instances also of long standing, ulceration takes place between the bladder and various contiguous parts, as the rectum, &c. These and analogous consequences of inflammation of the coats of the bladder, exist in different instances in every possible degree, even to gangrene of the organ; according to the severity of the attack, and the length of time it has continued. Of such cases, innumerable instances will be found in the different authors who have treated on the subject; to whom the reader is referred for further particulars.

The consequences of what we have termed *general* inflammation of the bladder, that is, of its cellular substratum, are still more severe and extensive. Besides more or less of the preceding appearances, the cellular membrane everywhere connected with the "bladder is found to be infiltrated with lymph and serum, and to a greater or less degree converted into a slough. If death has taken place at an early period, the intestines are found distended with air, and there is a very slight effusion of serum in that part of the peritonœum which descends to the pelvis. But if the patient has laboured under the symptoms for many days before he dies, the peritonœum, where it is reflected

* Lectures on the Urinary Organs, p. 207.

from the bladder to the rectum, is seen of a darker colour than natural, and encrusted with lymph; and at a still later period, there is the appearance of inflammation, to a greater or less extent, throughout the peritonæum generally. But the peritoneal inflammation is evidently not the primary disease; it is the inflammation and sloughing of the cellular membrane, which has induced inflammation of the adjoining portion of that membrane.” *

Of Inflammation of the Prostate Gland.—Inflammation of this organ, like that of the bladder, may be either chronic or acute; and as the chronic form of the disease, or, at least, what is so denominated, is by far the most frequent, we shall, as in speaking of the inflammation of the bladder, commence with a brief account of the leading symptoms of chronic inflammation of the prostate.

The disease termed chronic inflammation of the prostate, but which in the greater number of instances, perhaps, rather deserves the appellation of chronic *degeneration* of that organ, usually commences insensibly, and, apart from the mere mechanical effects to which it gives occasion, without any well-defined symptoms. In general it begins to take place soon after middle age, in conjunction with the congested state of the abdominal viscera and gradual decline which usually mark that period of life; and to which we have so often referred in this volume. There is a tendency to fulness of the hæmorrhoidal vessels, sometimes accompanied by bleeding; together with a sense of heat, and oppressive weight of the pelvic viscera in general, but referred more especially to the rectum and perineum. These sensations and symptoms at first come on at certain periods, particularly in the spring and autumn; but as the patient gets older, the periods of intermission become shorter; and during the winter months they are seldom entirely absent. The patient now begins to complain of a frequent desire to pass his urine, which he accomplishes with more difficulty than formerly; and the stream, instead of being projected to some distance from the body, as in health, falls almost perpendicularly from the urethra. All these symptoms go on increasing with age, and the bladder impercep-

* Sir B. Brodie. *Lectures on the Urinary Organs*, p. 329.

tibly becomes more irritable, and the difficulty of passing the urine greater; till at length the patient is unable to empty the bladder at all. During the progress of the disease, the quantity of urine retained in the bladder gradually increases, till that organ habitually remains in a distended state. Another train of symptoms now commences, arising from the habitual distension of the bladder; one of the most prominent of which is incontinence of urine, or at least an involuntary discharge of urine during the night; and it will be often found that the patient, after putting up with all the inconveniences of his disease till now, applies for the first time for medical assistance.

When the prostate is thus enlarged, it is exceedingly apt to become irritable; the difficulties, therefore, usually experienced by the surgeon in introducing the catheter, owing to the tortuous and irregular shape of the urethral canal where it passes through the prostate, seldom fail, though the operation relieves the patient from the immediate danger of his situation, to increase his sufferings in other ways. The whole of this subject, however, falls within the province of the surgeon; and the little we have to say on it will be given in a subsequent chapter, on Incontinence and Retention of urine. We proceed, therefore, in the next place, to speak of another consequence of chronic inflammatory excitement of the prostate, namely,

Prostatal Concretions.—Prostatal concretions, we have elsewhere stated, usually consist of the phosphate and carbonate of lime. Moreover, we have attempted to show that these earthy salts are in most instances of the present kind, the result of deranged action in a mucous membrane. While, therefore, the chronic inflammation or degeneration of the prostate above mentioned, involves chiefly the substance or textures themselves of the prostate gland; the disease now alluded to, may be supposed to be chiefly confined to the mucous membrane lining the ducts and cavities of the organ. In fact, earthy deposites are always found in these situations in the first place; though, as they increase in magnitude, they cause the absorption of the organ, and reduce it to the form of one or more cysts of various sizes, each filled or distended with one or more concretions. The distinct nature of the two preceding forms of chronic affection of the prostate gland, is further evident from the fact, that while the former

is very common, the latter is comparatively rare. That is, innumerable instances of simple enlarged prostate occur, in which no calculi exist; while, on the other hand, concretions are sometimes found in prostates, not remarkably, if at all, enlarged. No doubt the two affections may be, and sometimes are, associated; but there is reason to believe that this association is not so common as has been supposed.*

The quantity of earthy matter sometimes secreted by the prostate gland is almost incredible. Thus Mr. Wilson informs us, that he was in the habit of seeing a patient, who in the course of fifteen years voided as much at different times as would constitute four times the bulk of the whole gland.† As before observed, prostatal concretions sometimes collect into a few large masses; but more frequently they are found detached, and of all sizes, from that of a pin's head, to that of a hazel nut. In such cases, the number may amount to fifty or sixty or more, and the prostate feels to the touch like a bag of nuts.

The symptoms produced by the presence of concretions in the prostate are often obscure, and distinguished with difficulty from the symptoms accompanying other affections of that gland; or from those of stone in the bladder. The symptoms of course will vary considerably according to the size, number, and situation of the calculi. "When small and not projecting, they sometimes have produced so little uneasiness, as not to have been suspected during life; they are generally, however, attended with some difficulty in voiding the urine, and a sense of uneasiness about the neck of the bladder. This uneasiness is occasionally increased by violent exercise; but so it would be, did it proceed from stone in the bladder. When they project towards the urethra, or produce a difficulty of passing water, and an instrument is introduced, either to search the passages, or to empty the bladder of urine, they

* In these cases, the disease is incipient. Of course concretions of considerable size and many in number, cannot exist in the prostate without enlarging the bulk of the organ; but in such cases the enlargement is obviously the effect, rather than the cause of the disease. Chronic inflammation of the prostate, and of the mucous membrane lining the prostatal cavities and ducts, seem to bear the same relation to each other as inflammation of the bladder in general, and cystirrhœa.

† Lectures on the Urinary Organs, p. 354.

will in some instances be found to grate against it, giving the peculiar feel to the surgeon which cannot be mistaken ; but they may be pushed back by the instrument into the cavity of the prostate, so as not to be discoverable in several subsequent examinations.* When a number of these calculi have been lodged in a cyst in the prostate, they have been known to produce retention of urine, and various other distressing symptoms. I have seen such cases ; and many are related by authors.†

Of Acute Inflammation of the Prostate Gland and its consequences.—Acute inflammation of the prostate gland may take place at all ages and under all circumstances. In early life it most usually arises from neglected or maltreated gonorrhœa, stricture, &c., in advanced age, as the consequence of the chronic enlargement of the organ above mentioned ; or of the use of the instruments rendered necessary by such chronic disease. The symptoms differ somewhat in the two periods of life, but many of them are essentially the same, and as follow :

Acute inflammation of the prostate gland in advanced life, and when that organ is enlarged in the manner explained in a preceding paragraph, may, as just stated, originate from various causes, but most usually arises from the effect of the instruments necessary to relieve the retention of urine. In this case, the attack commonly commences with a rigor more or less severe ; which is soon followed by fever, and a sense of extraordinary heat and weight about the rectum and perineum. To these symptoms succeeds a continued throbbing pain, which is much increased by pressure, as by sitting ; or by the examination of the prostate through the rectum ; or by evacuations from the bowels. Generally also, after an evacuation from the bowels, however complete it may be, the sensation still remains of something being left behind. The urine is passed at short intervals, and with great pain and difficulty ; and sometimes there is complete retention. The urine is generally high-coloured, and occasionally contains mucus, and even blood. Under these circumstances, the pulse becomes accelerated ; the fever, which is often of a remittent

* Wilson, op. cit. p. 354.

† See among others, a paper by Sir B. Brodie, in the Med. Chirurg. Trans. vol. xii. page 382.

character, is much aggravated; and there is a tendency to delirium—in short, a train of symptoms is induced, which, if not speedily checked, rapidly involves the whole bladder, and terminates in suppuration and mischief, which may prove fatal to the patient.

Inflammation of this organ occurring in early life, and before the organ has become enlarged, is much less common than the preceding forms of the disease, and usually arises from gonorrhœa or stricture. This form of the disease is thus described by Sir B. Brodie : "The patient observes that the gonorrhœal discharge stains his linen much less than it did before, or that it ceases altogether; and he experiences at the same time a frequent inclination to void his urine, and a difficulty in voiding it. He complains of uneasiness and pain referred to the neck of the bladder, and extending forward in the course of the perinæum and urethra, and aggravated in each attempt to make water. In some cases there is a complete retention of urine. The impulse to make water is then violent and irresistible, and it is attended with more suffering than in ordinary cases of retention, on account of the urine which is accumulated in the bladder being pressed with force against the inflamed and tender prostate. There is a sense of fulness in the perinæum and rectum, and the prostate is manifestly tender when examined from the rectum with the finger.

" Not uncommonly, suppuration takes place, and an abscess forms, of which the symptoms in the first instances are generally obscure. As the abscess advances, the perinæum becomes tender; and there is a perceptible though slight tumefaction and hardness in some one part of it. The abscess, if left to take its own course, sometimes bursts internally—that is, into the urethra; more frequently it makes its way through the fascia, cellular membrane, and muscles of the perinæum, and bursts through the external skin.

" These local changes are attended with no small degree of disturbance of the general system. The pulse is frequent, the skin hot, the tongue furred; and the formation of matter is often indicated by rigors."*

The *causes* of these different forms of inflammation of the

* Lectures on the Urinary Organs, page 143, third edition.

bladder and prostate have in a great degree been already mentioned. It may not be amiss, however, to recite the leading circumstances in a connected form.

The *causes* of cystorrhœa are either predisposing or exciting. There are some habits certainly more disposed to this affection than others; such are those of an irritable scrofulous temperament, with fair skin and tendency to cutaneous affections; more especially if they have been accustomed to venereal excesses; or have suffered from these affections, or from gout. In such individuals the disease, which is properly a disease of old age, and more frequent in men than in women, may commence early in life, and in either sex, from any of the common exciting causes, and more especially from exposure to cold; such as by getting wet feet, sitting on a damp seat, &c.

This form of disease, on the whole, is most frequent in cold countries, and in cold weather; hence many suffer from it only in the winter and spring months; and in all it is apt to be much aggravated during these portions of the year. In some countries it is said to be so common as to assume almost an epidemic form; while in particular instances it takes on a periodic character; especially when associated, as it frequently is, with haemorrhoids, and with certain affections of a gouty character. Other exciting causes mentioned by authors, are acrid diuretics, long and excessive riding on horseback, the presence of worms in the intestinal canal, &c.

This tendency to chronic disease of the bladder, in which the prostate almost always participates, is, perhaps, one of the most frequent and strongest predisposing causes of acute attacks of inflammation in both these organs. With such predisposition the exciting causes may be stone in the bladder; exposure to cold; the use of instruments; any injury or accident particularly affecting the bladder or its neighbourhood; all of which, with many similar circumstances, may excite acute inflammation in the bladder and prostate, with their fearful train of consequences, even in the healthy state of the organs; but more especially in the chronic state of predisposition above mentioned. In females, a very frequent exciting cause of acute inflammation of the bladder is some disease, or other affection of the uterus or its appendages. Lastly, another fertile cause of chronic inflammation, or rather

of irritation of the bladder, &c., are certain renal diseases. These, however, more properly fall to be considered in the next paragraph.

2. The second great section of diseases connected with the bladder and prostate, are those of an *irritable* character; and resulting either, *a.* From functional derangement; or from degeneration, natural or malignant, of the urinary organs; or *b.* From nervous affections of a remote and constitutional origin.

a. Diseases of an irritable character, originating in the urinary organs themselves, may either depend on functional, or on organic derangements of the kidneys; or on functional, or on organic derangements of the bladder and prostate, &c. Such affections, therefore, constitute two natural subdivisions; though it may be remarked that the two subdivisions seldom remain distinct; for when the kidneys are affected, the bladder always ultimately becomes involved.

Cases of irritable bladder depending on functional derangement of the kidneys usually result from the unnatural properties of the urine. Healthy urine, however heterogeneous and stimulating in its properties, and however deleterious its action may be when brought into contact with the living textures of the body in general, constitutes, nevertheless, the *natural* and proper stimulus of the renal and vesical cavities. All deviations, therefore, from the normal condition of the urine, whether in deficiency, in excess, or in kind, are recognised by the containing organs, and may prove a cause of *feeling*—in other words, a source of irritation in the kidneys and bladder. Hence, whenever the urine is very dilute or very concentrated, or is preternaturally acid, or alkaline; or contains any unnatural ingredient; the urinary organs in general, and the bladder in particular, though perfectly healthy, are liable to become excited and irritable; and the individual has no peace till the unnatural secretion be discharged. In such cases, the fault lies, not in the bladder, but remotely in the kidneys and assimilating organs; and in this mode, and to this extent, the bladder may occasionally become irritable in all individuals at all ages; but in the young and healthy, such irritation is temporary only, and subsides with the operation of the causes. The dyspeptic suffer most of course; and those whose powers of assimilation are weak, and who pay no regard to diet, gradually

lay for themselves the foundation of much suffering in after life. In this way, in short, a great number of cases of permanent derangement of the bladder, &c., are acquired; the organs in time (participating perhaps in the natural staminal defects of the system) becoming more or less diseased, either superficially, *i. e.* as regards the mucous membrane; or substantially, as regards the organs in general.

Cases of irritable-bladder depending on organic affections of the kidney, are in general of a very formidable kind, and come in the next place to be briefly considered. Organic diseases of the kidney assume a great variety of forms; and we have already entered considerably into the subject in our section on serous urine. What has been there stated we shall not repeat; but shall merely observe that some of the affections formerly described as connected with anaemotrophy, are so nearly related to, or so imperceptibly graduate into, the class of affections to be now briefly described, that it becomes impossible to draw the line of distinction between them. The class of diseases to be more especially considered in this place, exists in various forms; but there is one form of disease which seems to constitute the groundwork of the greater part of them. This, in the first place, we shall attempt to describe; and afterwards point out some of its most remarkable varieties, complications, and consequences; all of which, it may be observed, sooner or later involve the bladder as well as the kidneys.

The most simple condition of the disease to be now considered, appears to be principally confined to early and middle age; and is comparatively of rare occurrence in advanced life. I believe, in almost all instances, that it is connected with an inherited cachexia, of which struma constitutes one of the ingredients, and very frequently a remote syphilitic, or malignant taint another. Hence in early life more especially, it is often connected with the oxalic acid diathesis, and with anaemotrophy of the system; nor have I ever seen it connected with a decided lithic acid diathesis; or with that peculiar haemotrophic tendency which usually accompanies this diathesis. The diseased action for the most part commences imperceptibly, and at first attracts but little of the patient's attention; but as it proceeds, the symptoms gradually become more urgent, and the patient is induced to apply for medi-

cal assistance; when the following phenomena and symptoms, in various degrees of intensity and variously modified, are usually found to be present:

First as regards the urine. The urine is generally acid; of a pale greenish, whey-like colour; opalescent, from the presence of minute flocculi, or particles of diseased epithelium or mucus; of low specific gravity; (that is, generally below 1·020;) often serous, but rarely bloody.* Sometimes, on being heated, it deposits the phosphates; but the lithate of ammonia is seldom so abundant as to be spontaneously separated on the cooling of the urine; and when this circumstance does take place, the colour of the sediment, instead of being yellow or red, is usually of a greyish ash-tint. After standing for some time, the urine becomes clearer, but seldom acquires perfect transparency even by filtering; and the peculiar sediment in general is very easily remixed on shaking.

In conjunction with these appearances of the urine, the patient usually complains of the following symptoms. There is a frequent and urgent desire to pass water; the period varying from one to three hours, and the quantity from one to two or three ounces, both by night and by day. At the moment of passing water, and for some time afterwards, there is an uneasiness, sometimes amounting to severe pain, felt along the whole of the urethra, but particularly just behind the scrotum; and of this uneasiness or pain, a sense of burning or scalding is one of the elements. There is no mechanical impediment to passing the water; and in the earlier stages, after a short time, the whole uneasiness subsides, and the patient remains quite well, till the period arrives when he is called upon, as before, to empty the bladder. As the disease advances, all these symptoms become augmented. The unnatural properties of the urine, and of the mucous deposite, increase; the symptoms, and particularly the calls to pass the urine, are more urgent and frequent; the general health and strength, which from the commencement had been disordered and enfeebled, now daily decline, and the patient

* This turbid state of the urine from the presence of diseased epithelium, &c., distinguishes the present affection from *serous urine* connected with simple anaemotrophic degeneration of the kidneys, in which the urine is generally quite transparent.

becomes emaciated, weak, and irritable, and more than ever susceptible of the influence of atmospheric changes. During the whole of this period, there is but little uneasiness felt in the region of the kidneys, and what little there may be, is usually referred to weakness. On minute inquiry, patients will sometimes admit the existence of a dull aching sensation in the loins, and occasionally darting pains down the course of the ureter, and even to the testicles, &c. ; but these are so trifling compared with the bladder sensations, that they are seldom complained of, unless particularly inquired after. The termination of the complaint is various; most frequently, perhaps, as follows:

The pulse gradually becomes more quick and feeble, and the stomach, from being weak and disordered, often rejects what is taken, so that the patient is very apt to be sick after eating. At the same time the urine, though not improved in quality, is diminished in quantity, and the calls to pass it are in consequence less frequent. The patient complains of nothing, but he daily becomes more indifferent and drowsy; as the sickness increases, the urine is still further diminished in quantity; at length every thing is rejected, the secretion of urine ceases altogether, and the patient expires, generally in a comatose state. Occasionally the termination is more sudden and unexpected; and in such instances, inflammatory symptoms have been generally superinduced from exposure to cold, or some other exciting cause. Now and then the patient becomes phthisical—in short, the fatal termination, though always certain, may be various, and depend upon the peculiarities of the patient's constitution, and accidental circumstances.

I have described this form of disease as we most frequently meet with it. But it may be remarked, that instances of this, or some very similar affection, occur, in which everything else is present, except the irritability of the bladder; which is not remarkable even to the last. In such cases, the pain is sometimes (not always) referred more to the back; in other instances, the quantity of urine may be greater than in health, and the patient fears he labours under diabetes; or that he is impotent, &c. I have seen all these, and various other modifications of the constitutional symptoms, attended by a condition of the urine very similar to those above described; and

ultimately, after a longer or shorter period, terminating unfavourably.*

The affection occurs in females as well as in males, but, according to my observations, much less frequently. The symptoms in this case are somewhat modified, and are occasionally accompanied by an increased vascularity and tumefaction about the orifice of the urethra; which, as well as the whole urethra, are exquisitely irritable, and appear to the patient to be the chief seat of her suffering. On examination of the urine, however, it will be often found that it coincides, in almost all respects, with that above described—showing that the kidneys are deeply involved and perhaps the primary seat of the affection.

We have stated, that a predisposition to this disease usually exists in the form of a peculiar cachexia; and with such a predisposition, the exciting causes may be various, and scarcely need recital. The pathological history of the affection is obscure, and has not yet been so satisfactorily investigated as it deserves to be. The following imperfect sketch is offered as the result chiefly of my own observations on the subject.

Under common circumstances, and as far as the urinary organs are concerned, the complaint most usually commences in the kidneys; and in some instances, I believe, it is either congenital, or at least commences in very early life. The whole secreting structure of the kidney seems to be more or less involved; and when the complaint is established, (perhaps before, or contemporaneously with its establishment,) the *mucous membrane* lining the cavities of the kidney takes on a peculiar diseased action, capable, in certain states of the system, of being propagated to those parts of the membrane which are as yet healthy. When the peculiar disease of the mucous membrane has spread to all parts of the kidney, it at length extends down the ureter to the bladder. In such cases, judging from what I have once or

* As instances of the modifications alluded to, I may mention that I have seen two cases in which all the distressing symptoms disappeared for many months before death, and the individuals became fat and apparently well. During this period I had no opportunity of seeing the urine; but learnt that the kidneys in both instances, and the bladder and prostate in one instance, were found after death (which took place rather suddenly) to be in a state of complete organic disease.

twice noticed, the diseased action sometimes (perhaps most frequently,) commences in the bladder, about the orifice of the ureter; from which part it gradually spreads to the neck of the bladder. At other times, the mucous membrane about the neck of the bladder appears to be the part first, or at least very early affected.* While the affection is confined to the kidney and fundus of the bladder, the degree of irritability of this organ is generally not remarkable; and the patient may be perhaps called up once or twice only during the night, &c. But when the mucous membrane about the neck of the bladder, and commencement of the urethra, are involved, all the symptoms of what is called irritable bladder, become fairly established in their most troublesome form. With respect to the peculiar or intimate nature of the affection of the mucous membrane, I can say but little. In common language it may be called inflammation; but this does not by any means convey, to my mind at least, a just notion of its characters. I should call it a species of *degeneration*, rather than of *inflammation*; that is, of *perverted* or *diseased*, rather than of *increased* action. The mucus is not increased in quantity, as in cystorrhœa; † or at least if it be, its *qualities* are totally different from the mucus of cystorrhœa. That is to say, it does not adhere together inropy masses; nor does it appear usually to assume a distinctly purulent form, like

* Several of the cases described by Mr. Coulson, under the denomination of Acute Inflammation of the Mucous Membrane of the bladder, seem to me to be nearly allied to this form of disease. I have reason to believe that the present disease often exists for years in a chronic form, and confined chiefly to the kidney; that when the degenerating process reaches and attacks the bladder, it sometimes assumes, either spontaneously or from accidental circumstances, a more acute form, and terminates fatally, like those described by Mr. C., with complete destruction of the mucous membrane of the bladder, &c. It is remarkable, that in all Mr. C.'s cases, one or both kidneys (generally the left) was found in a state of disease; and this circumstance, taken in conjunction with my own observations, has induced me to form the present opinion, which, however, I advance with diffidence.—See Coulson on Diseases of the Bladder and Prostate, page 80, third edition. Also this volume, page 367.

† Except, perhaps, in the acute form of the disease, when the mucous membrane appears to be occasionally involved in the acute inflammation which sometimes precedes or accompanies the degenerating process.

the mucus of cystirrhœa. On the other hand, it partly consists of imperceptible particles easily diffusible through the urine, and with difficulty separated from it ; and partly of shred-like, ill-defined visible particles apparently consisting of diseased or altered epithelium.

This species of degeneration is not confined to the mucous membrane. On the contrary, it seems to extend to other, or analogous structures ; hence the organization of the kidney, as well as its membranes, become involved, and more or less destroyed ; and sometimes one or both kidneys contain oxalate of lime or phosphatic concretions. Lastly, it may be observed, that the general characters of this species of degeneration, in its simplest and best defined form, are destructive ; rarely cumulative, or hypertrophic. The texture attacked, whether it be mucous membrane or any other analogous texture, is gradually destroyed, and disappears ; and when the affection exists in its worst form, the restoration of healthy action in a part once involved, seems to be impossible. Moreover, in the last stages of the disease, the morbid cachexia appears to actively pervade the system ; and not only the whole of the inner membrane of the bladder, &c., but the liver, spleen, intestines, and even the lungs, are found in a state of organic change.

When the peculiar diathesis marking the above affection is less decided, and when the strumous diathesis usually associated with it, predominates, the disease in earlier life sometimes shows itself in the form of tumours of various kinds. These tumours occasionally contain depositions of a plastic greyish matter, or partake of the character of nævus, &c. ; at other times they are associated with peculiar cutaneous affections. Sometimes, among members of the same family subject to these affections, we see one or more liable to insanity ; others to excessive irritability of the skin ; others, in early life, to a disposition to phthisis, or in middle life, to asthma ; or, if they have been exposed to malarious influence, to affections of the liver and spleen. The object of these remarks is to show, that in a system thus predisposed, the kidneys and bladder, on account of their intimate connexion with the sexual organs and functions ; and on account of the innumerable diseases to which these organs are exposed, are peculiarly liable to come in for their share of the mischief. The affection of the kidneys and bladder above described, therefore, may arise in some instances

spontaneously, and as a natural consequence of the inherited tendency, as already stated ; but I need not say that the disease is much more frequently excited by some abuse or error in diet, &c. ; or by local excitement or disease established in the genital organs. When once established, however, in a predisposed habit, be the exciting cause what it may, the mischief proceeds [more or less rapidly, and too frequently without intermission, to its fatal termination.*

I have mentioned, that when affections of the bladder originate in renal disease, the orifice of the ureter on the side affected, and the neck of the bladder, are the two parts of that organ most liable to become diseased ; and that, according to my observations, the orifice of the ureter is generally the first point involved. This tendency to early affection probably results from the prior and constant contact of the diseased products with those particular portions of the bladder ; the mouth of the ureter being first exposed to the unnatural matters constantly passing through it ; the neck of the bladder to the constant contact of such matters, naturally gravitating to it by the position of the body. For the same reason also, the orifice of the urethra in females is apt to take on the diseased action, as already stated.

Having thus described what may be considered as the fundamental characters of organic affections of the bladder originating in kidney disease, we may briefly notice some of those rarer complications which occasionally occur in practice ; and which, from the irritability they occasion in the bladder, are liable to be confounded with calculus. Such are various *excrescences* from the mucous membrane of the bladder. These are not common, and when they occur, they usually occupy the inferior and posterior portions of the bladder. If not complicated with the above cachexia, they are usually harmless, and only cause inconvenience by their mechanical effects. We read also of *polypous excres-*

* I have noticed that individuals inheriting this tendency are not only more liable to, but suffer more from epidemics, at fever, cholera, &c., than the healthy. For the same reason, various exciting causes, such as the use of ardent spirits for example, in a moderate degree only, will in such individuals sometimes establish irremediable organic mischief in the kidneys, liver, &c. Such individuals, therefore, should be more than ordinarily cautious how they expose themselves to mischief. See the section on *serous urine*.

cences, elongations, &c., of the inner membrane of the bladder, and a variety of other rare and non-malignant affections in systematic writers on the subject; to whose works the reader is referred for particulars. The only affection of the kind we shall notice, is of a more formidable character, viz. *fungus hæmatodes*, a tumour rendered malignant by being complicated with the above cachexia; and which, in its earlier stages, is often liable to be mistaken for calculus in the bladder: and indeed is with difficulty distinguished from such affection.

The few cases I have seen of fungoid excrescences from the bladder, have occurred in individuals who have either naturally laboured under the peculiar (or some nearly allied) cachexia above described, in an exquisite degree; or who from various exciting causes, as for instance, residence in a malarious locality, &c., have had such natural constitutional tendency much aggravated. In a case, occurring in a peculiarly cachectic individual, in whom one of the kidneys had been probably diseased from early life, the affection seems to have existed for many years, perhaps from birth, as an indolent tumour in the fundus of the bladder, near the mouth of the ureter belonging to the diseased kidney. This tumour (as was found to be the case after death) contained a large quantity of phosphate of lime, and seemed to have latterly increased in size, so as to have occasioned a certain degree of irritability of the bladder; on account of which, under the apprehension that there might be stone in the organ, the patient was induced to apply to a surgeon. The sound was introduced, and apparently came in contact with the tumour and wounded it; as considerable pain and vesical haemorrhage followed the operation. From this time, the haemorrhage continued at intervals, and at length became almost constant. The irritability of the bladder (though never very urgent, and never accompanied by retention of urine) became rapidly worse, and this, together with the loss of blood, &c., visibly began to affect the general system. The nature of the affection, which had been suspected from the beginning, became at length too evident. The urine now constantly contained large quantities of dark grumous highly offensive bloody matter, mixed with clots; and, in the latter stages, with fragments of the medullary substance of the tumour. In a short time afterwards, and a few months only after the opera-

tion of sounding, the patient sank under the affection, quite worn out and exhausted by his sufferings; and on examining the bladder after death, a large fungoid mass, like a bunch of grapes, was found attached to the tumour above described, in the fundus of the bladder. The base of this tumour extended to the neighbouring parts, and particularly involved the mouth of the contiguous ureter; which was much enlarged, and the kidney on that side had evidently long been in a state of disease, as above mentioned.

The preceding may be regarded as an extreme case; the progress of the affection is sometimes much slower, and when the disease commences, as it sometimes does, in the kidney, and is propagated downwards into the bladder, the patient occasionally lives for years; sometimes with intervals of comparative freedom from inconvenience of any kind, and particularly from haemorrhage, which is one of the most frequent symptoms. Sooner or later, however, the complaint takes a decided turn; the haemorrhage becomes almost constant, and this, by further debilitating the system, renders the patient still more liable to the inroads of the disease, which progresses more rapidly than ever, and speedily proves fatal.

In the case above described, the disease chiefly occupied the fundus of the bladder; but according to Sir B. Brodie, and indeed according to my own experience, the affection most frequently attacks the neck of the bladder or its neighbourhood. In such cases, the sufferings of the patient are always very much augmented by the mechanical impediment to the passing of the urine, occasioned by the tumour.

Cancer of the urinary organs, and particularly of the bladder, is said to be a very rare disease. I have seen repeated instances, in which cancerous ulceration has extended from the uterus, rectum, &c., to the bladder; but I have seen no case of cancer, which could be said to have commenced in that organ, or in its appendages.

The above affections originate in the system in general, or in the kidneys, and only secondarily involve the bladder. We have now to briefly consider those affections connected with the bladder itself, and its appendages; and which not only prove a source of irritable bladder, but are liable to be mistaken for, or complicated with, calculus in that organ.

An irritable state of the bladder, occasioning frequent calls for micturition, may be the chronic result of the thickening or other disease of the coats of the bladder, or of the contracted state of that organ, formerly described as the consequences of inflammation. A similar train of symptoms may also arise from an enlargement, or other disease, of the prostate ; which may or may not accompany the above state of the bladder. Another fertile source of irritable bladder, and indeed of a great deal of mischief not only in that organ and its appendages, but even in the kidneys themselves, is stricture of the urethra. The management of this falls entirely within the province of the surgeon ; and the subject is mentioned only with the view of observing, that as long as the stricture remains, nothing can be done towards alleviating the patient's sufferings. The first object of the surgeon, therefore, will be to remove all mechanical obstruction from this organ, and very often, when this is accomplished, every symptom will vanish ; that is to say, provided the bladder and kidneys have not, from the long continuance or mismanagement of the case, become organically affected ; which is too often the case, particularly in strumous and cathectic habits.

There are only two other affections which appear to belong to our present subject, viz., Gouty and Rheumatic inflammation of the urethra. I am unable to state whether these two affections be distinct diseases, but I believe at present that they are ; and that, like gout and rheumatism, they sometimes exist in conjunction. Gouty irritation of the urethra often assumes all the characters of gonorrhœa, and is not only attended by a profuse discharge, but with great irritation and scalding in passing water. The bladder and prostate often participate in the affection, and become highly irritable ; so that the calls to pass the urine are painfully urgent and frequent. I have seen repeated instances of such attacks ; by far the greater proportion of which have occurred in those who have had a strong predisposition to gout, either inherited or acquired, but who have never had gout openly. In the greater number of these cases, I have not been able to trace the affection to any distinct cause. In a few instances it seems to have been produced by sexual excitement.

Rheumatic gouty irritation of the urethra sometimes attacks those who labour under the affection in other parts of the system ;

of which I have seen instances. This is by far the most troublesome form of the disease; not so much from its severity, as from the obstinacy with which it resists the action of remedies. A very troublesome species of rheumatism also, nearly allied to rheumatic gout, sometimes attends or follows common gonorrhœa. When I state that this species of rheumatism is nearly allied to common rheumatic gout, I mean as regards the symptoms. Whether the two diseases be absolutely identical, I do not pretend to determine. I believe the two diseases, however, to be nearly allied in their nature, as well as in their symptoms.*

I do not think it necessary to enter into details respecting any of the above affections, many of which indeed, as far as it is my present purpose to notice them, have been already described as the consequences of inflammation of the bladder and prostate. I pass on, therefore, to the second general division of affections connected with irritable bladder; namely,

b. Irritable affections of the bladder connected with the *nervous system.* "Irritability of the bladder," says Sir B. Brodie, "is sometimes the result of mere nervousness; of the same state of the bladder, which in some other individuals occasions a constant winking of the eyes, or twitches of the muscles of other parts. The frequent expulsion of the urine, when once begun, is kept up by habit; the bladder becomes less capacious than it ought to be, and it is not till after a lapse of time, nor without some effort on the part of the patient, that it is restored to its natural condition." † It may be remarked, however, in addition, that in such cases the functions of the kidney almost always participate in the irritation; and that on inquiry the urine is not only increased in quantity, but becomes deranged in its properties; that is, the secretion has a specific gravity below the healthy standard, often approaches to neutrality, and deposits the phosphates on exposure to heat; and is sometimes even slightly serous.

Sir B. Brodie also mentions another form of irritable bladder, which is occasionally a symptom of disease in, or affecting,

* This affection, which is frequently combined with ophthalmia, has been described by various authors; but the reader is more especially referred to a Clinical Lecture by Mr. Lawrence, in the Medical Gazette, vol. xxiii. page 506.

† On Diseases of the Urinary Organs, p. 95, third edition.

the nervous system. "An elderly man, for example, complains of frequent attacks of giddiness. Sometimes in walking, his head turns round, so that he is in danger of falling; and this symptom probably arises from altered structure of the arteries of the brain, causing an imperfect state of the cerebral circulation. Not unfrequently this is attended with an irritable state of the bladder; and although the urine is of a healthy quality, and the bladder itself is free from disease, the patient is tormented by a constant micturition, voiding his urine without pain, but at short intervals and in small quantity at a time. Little can be done for the patient's relief in such a case as this; but it is important that the real nature of the affection should be understood, that if we cannot effect a cure, we may avoid tormenting him with useless remedies." *

I have seen cases resembling the above, and have generally observed that sooner or later they have terminated in apoplexy, or paralysis. In no case of the kind, however, that I have seen, has the urine been quite natural: and it has been usually of high specific gravity, and abounding in urea; or sometimes in the lithic acid.

Affections of the kidneys and bladder, connected with organic disease or injuries of the spine, have been already mentioned, and need not be here further noticed. We proceed, therefore, to make a few remarks on spasmodic and paralytic affections of the urinary organs, and particularly of the bladder.

Spasm of the bladder often accompanies the presence of a stone in that organ, as well as many other affections before described, to which the bladder and its appendages are liable. It not unfrequently also accompanies diseases of the kidneys, rectum, uterus, &c., and in some instances has been known to recur periodically. There is also an idiopathic spasm of the bladder mentioned by some authors, to which old men are said to be particularly liable; though the existence of such a disease seems to be doubted altogether by others, who consider it as merely symptomatic of some other disease.

In the particular affection alluded to, as well as in other instances of spasmodic affection of the bladder, the patient experiences an acute pain in the region of the organ, accompanied

* Op. et. loc. cit.

by a sense of constriction. This pain often extends along the urethra, and sometimes gives occasion to the most distressing erections. There is more or less of retention, and occasionally of suppression, of urine, on account of this secretion not being able to enter the bladder. In case of suppression the urine accumulates in the ureters, &c., which become distended and painful; and the pain is propagated to the kidneys, loins, testicles, and even to the thighs; and is often accompanied by nausea, or hiccough. The bladder is generally contracted, and resembles a hard ball; in which contracted state, by pressing on the rectum it produces a desire, without the power, of going to stool, and sometimes causes protrusion of the rectum. These symptoms are accompanied by great uneasiness, agitation, and restlessness, with a cold clammy perspiration extending more or less over the body; and in those unfortunate cases, in which the spasm continues, in spite of remedies, for some hours, the extremities become cold, the patient falls into a state of syncope or convulsions, and death soon succeeds. In other instances, the patient dies with all the symptoms attending suppression of urine.

Besides stone in the bladder, spasm of that organ may arise from, or rather accompany, various other affections; such as from the presence of acrid urine or pus from an abscess in the kidney; from ulceration or other organic disease of the bladder, prostate, &c.; from retention of urine; from gout; from excessive venery, or the use of irritating diuretics, as cantharides; from various diseases of the intestinal canal, as worms, and especially ascarides; from hysteria, &c. Slighter cases in young subjects are in general not dangerous, and sometimes subside spontaneously. The affection is most dangerous in old people, and in proportion to its duration and intensity; and when the spasm depends on a cause that cannot be removed, it is very apt to end in the affection to be next briefly noticed, viz.

Paralysis of the bladder.—Paralysis of the bladder may either creep on imperceptibly as the result of age, and of weakened powers in general, conjoined with an enlarged prostate, or other affections of the urinary organs; or it may take place more suddenly, from some peculiar lesion or other affection of one of the great nervous centres, and particularly of the spinal cord. The description of these forms of paralysis, therefore, will consist in

little more than a brief recapitulation of the symptoms described, under various heads, in the foregoing pages.

The paralysis of old age is usually one of the concomitants of an enlarged prostate. The enlarged prostate presents an obstacle to the free passage of the urine, while the muscular structure of the bladder, either from partaking in the rigidity and thickening of the prostate, or from want of power, ceases to exert the force requisite to expel the whole of the urine from the bladder. The consequence is, that the bladder constantly retains a certain portion of urine, to the stimulus of which, from the diminished sensibility of the organ, it becomes insensible. This quantity of retained urine gradually increases as the disease proceeds, till from the greater difficulty about the prostate, and the long-continued over-distension of the organ, the bladder loses its power of contraction altogether. In such cases, the bladder sometimes becomes enormously distended; and the excess of urine subsequently descending from the kidneys, begins to flow off involuntarily, without, however, diminishing the tension of the bladder; which at length, as well as the kidneys, become diseased; and the patient, if not previously cut off by the other more urgent symptoms of the affection, dies from the local disease set up in the kidneys and bladder. From the diminished sensibility of the bladder, in many cases of paralysis of that organ, the patient is not conscious of its distended state, and consequently suffers but little pain; particularly if the excess of urine flows off imperceptibly, in the manner above mentioned. In other cases, the patient complains of a sense of uneasiness, weight, and tension about the region of the organ; with numbness, and often severe cramps in the lower extremities, and more or less of impediment or inconvenience in the passage of the faeces, &c. The *incontinence* of urine connected with paralysis of the bladder will be considered more fully in a subsequent chapter.

It remains, in the last place, to make a few remarks on the class of nervous affections of the kidneys and bladder, which, for want of a better name, may be arranged under the general denomination of *hysteric* affections.

The peculiar aberrations, mental and bodily, involuntary and voluntary, connected with the female character and functions,

and generally known under the name of hysteria, are so numerous and varied, so unexpected and improbable, that a volume might be occupied in describing them. We shall confine our attention principally to those affections of an hysterical character more especially involving the urinary organs; which, for reasons sufficiently obvious, are among the most frequent as well as the most important.

Perhaps there is not a disease to which the urinary organs are subject, that has not its counterpart or similar in hysteria. Innumerable instances have occurred to me, for example, in which calculi have been said to be passed from the kidneys and bladder by hysterical females. Such calculi I have examined, and found them to consist perhaps of a fragment of silex, or even of brick,—in short, of anything but what is known to be of urinary origin. Moreover, in some of these cases, a train of symptoms, resembling those accompanying nephritic attacks, have been stated to accompany the descent and exit of the calculus from the kidney and bladder; and so accurately have these symptoms been simulated and described, that neither those who have witnessed them, nor those who have heard them described, have appeared to doubt the reality of the attack, till the pretended calculus has made its appearance; when its chemical properties have at once dispelled the illusion, and demonstrated the true nature of the affection. In such cases, I have even seen the properties of the urine changed, (I know not by what means,) so as to correspond with the symptoms described; and there has been blood or mucus, or other unnatural matters, present in the secretion, as it were at the will of the patient.*

* I may mention, by way of illustration, a striking instance that occurred to me many years ago. The patient was a remarkably sedate individual, between thirty and forty years of age—in short, the last person one would have suspected. She had for years, according to her own account, suffered from nephritic attacks, the symptoms of which she described in all their minutiae, with the greatest accuracy. She had never passed calculi; but the attacks above mentioned were attended and followed by large deposits of a white substance in the urine; which was generally alkalescent, and apparently much deranged. This white substance proved on examination to consist chiefly of carbonate of lime, with some phosphate of lime,

One of the characteristic symptoms of hysteria, as is well known, is diuresis; and on occasions in which this symptom occurs, the quantity of limpid urine, or of mere water that is passed, is sometimes extraordinary. At other times, suppression of urine is a (pretended) symptom, and the patient declares that for days together she does not void any water. Retention of urine is another occurrence; and the patient either cannot, or, as some suppose, *will not*, empty the bladder without mechanical assistance. All these affections, however, are obvious in their nature, compared with those obscure affections of the spinal chord, or column; of joints, &c., which are not unfrequently met with in females, and which appear in many instances to belong to hysteria, or at least to be modified by that affection. Such affections have been described by Sir B. Brodie, and are well known to our most experienced surgeons. Formerly, however, the nature of these affections was entirely overlooked: and even still, perhaps, they have not been so generally studied as they ought to be. The consequence was, perhaps still is, that many a poor girl has been confined upon her back for months, and even for years; and for the cure of an imaginary disease, her health and prospects in life have been sacrificed in reality.

In investigating hysterical cases, we should constantly remember, that the utmost duplicity and cunning may be displayed, where, from mere appearances, we should expect nothing but the most rigid truth—in short, that the whole energies of the patient's mind are bent on deception; and consequently that the decep-

and triple phosphate of magnesia and ammonia. At length, circumstances raised a suspicion in the mind of the gentleman who usually attended her; and on closely pressing her, and threatening exposure, she confessed that the whole was a deception; and that she had been in the habit of mixing quick lime or chalk with the urine, and thus of producing the appearances above mentioned. I learnt on inquiry that some members of this lady's family were insane. Hysterical females are subject, on certain rare occasions, to pass urine nearly black; and I have known this appearance kept up artificially for a long time together, by the admixture of ink with the urine. I have also occasionally seen hysterical urine not only strongly serous, but otherwise deranged, so as to cause alarm about the state of the kidneys and bladder: yet the whole has after a time disappeared, and the patient has become quite well.

tion is likely to be greater, and more difficult of detection, in proportion as the patient is more highly educated, or has been more frequently seen and examined. Moreover, the sex, the age, the apparent sufferings of the patient all conspire to interest us in her favour, to warp our judgment, and to unfit us for an impartial inquiry into her case. One of the best modes of proceeding, therefore, at the outset, is to make the patient describe her own feelings, in her own words; and if possible in her own handwriting. At any rate, the principal symptoms, as stated by herself, should be written down, *before a single question is asked.* Indeed, leading questions in all such cases should be most carefully shunned; for though the symptom inquired after may not be present at the time, yet the hint will be carefully treasured up in the memory; and the symptom will not fail to appear at some future time. Hence, as just observed, in hysterick affections the symptoms generally become more numerous and urgent, in proportion as the patient becomes more knowing. I state this with pain and reluctance; but when we consider that the character of the medical man in attendance, no less than the well-being of the patient, is at stake, it becomes our duty, for the sake of both parties, to place the matter in a strong light. As to the *motives* of the patient for such deception, that is another question. To become an object of attention,—an interesting object, is an innate and characteristic feeling of the female mind; and if in early life this feeling, in its natural and legitimate form, has been thwarted or disappointed, it is almost sure to deviate into some other channel; and the ruling passion is displayed in attempting to excite pity and commiseration, where she cannot excite erotic sentiment. This, however, may be said to be a question of morals, rather than of medicine. I shall not, therefore, pursue the subject further, but shall merely observe, that all the worst cases of hysterick aberration that have fallen under my notice, have appeared to be fairly referable to an exalted or modified condition of the above mentioned innate female feeling; tinctured perhaps, in some instances, by remote shades of insanity.

We shall now take a brief recapitulatory review of the principal subjects discussed in the present chapter, chiefly with reference to diagnosis and prognosis. And it may not be irrelevant

to mention at the outset, that in most of the preceding diseases, the great object of our diagnosis, on which of course the prognosis in no small degree depends, is to determine, in the first place, the presence or absence of stone in the bladder, or of other mechanical disease; that is, whether the symptoms present depend on, or are in any way connected with, vesical calculus; or on stricture, or other mechanical obstruction about the neck of the bladder or urethra.

With regard to the presence of stone in the bladder, though it may be rendered probable, the fact cannot be possibly determined by the mere symptoms; and the mechanical assistance of the surgeon is necessary. In all cases of doubt and difficulty, therefore, where the circumstances of the patient will admit, the operation of *sounding* should be resorted to in the first place. This operation falls entirely without my province; and I shall merely observe, that however dexterously the sounding may be performed, a single negative result is in no instance to be considered as decisive—indeed, I have known a stone subsequently found in the bladder after repeated negative results. In such instances, blame is by no means necessarily attributable to the surgeon. The stone might have been encysted; or lodged in a fold of the bladder; or behind an enlarged prostate, &c.,—circumstances, which though, at the time of sounding, they sheltered the stone from the contact of the instrument, may, from their temporary character, be subsequently removed, and the stone thus liberated. When a stone of moderate size exists loosely in the bladder, it can scarcely escape the tact of a dexterous surgeon.

Similar remarks may be made respecting the determination and removal of mechanical obstructions about the neck of the bladder or urethra; the existence or absence of which should be determined at the very outset of the inquiry. This part of the inquiry, however, like that of sounding, falls entirely within the province of the surgeon; and, by careful management on his part, the mechanical impediments may be often removed or relieved; and when such removal or relief has been timely accomplished, the whole train of bladder and even of renal symptoms, (which, if the impediment had been permitted to have remained, would have ended in destruction of these organs,) sometimes entirely disappears.

When the surgeon has declared that neither stone exists in the bladder, nor mechanical obstruction in the urethra, &c., we must form our diagnosis in the best manner we are able from among the symptoms. If the urine be acid, but abounding in ropy mucus possessing alkaline properties ; if there be a constant and urgent desire to void urine, which is attended with difficulty, and more or less of smarting pain along the whole urethra ; if there be a dull pain and sense of debility about the back and loins, and more or less of low remitting fever, we may infer that the mucous membrane of the bladder is in a state of chronic but incipient inflammation ;* if the copious deposition of ropy mucus in the urine, which formerly existed, has become diminished in quantity, and the secretion has assumed a glairy, or an opake, or purulent appearance, and is mixed with blood ; if the urine has become permanently alkaline, and the desire to pass it more urgent and frequent than ever ; if there be increased pain on pressure over the pubes ; if the low feverish symptoms have assumed more of a hectic character—we may presume that the chronic inflammation of the bladder has reached that point at which the mucous membrane has been more or less destroyed—in short, that the patient has arrived at the last stage of the complaint, and will probably sink under its effects.

When, after a surgical operation about the bladder, rectum, &c., or after exposure to cold, or other exciting cause, a patient labouring under any urinary disease experiences the following train of symptoms, we may conclude that general inflammation (of the cellular substratum) of the bladder, &c., has taken place ; and that the affection will almost certainly prove fatal. Rigor, followed by faint perspiration, malaise, and disinclination to take food ; pain extending more or less, especially on pressure, to all parts of the abdomen, back, and rectum ; acceleration of pulse ; and a peculiar anxiety of expression ;—when to these symptoms, which rapidly increase, there begin to be superadded intermission of the pulse ; a brown and dry tongue ; occasional hiccough ; a tympanitic state of the abdomen ; and great prostration of the vital powers—the fatal event is near and inevitable.

A difficulty and frequent desire of passing the urine, particularly when it occurs in a middle-aged or old individual, and is accompanied by incontinence of urine during the night, is

almost a certain indication of chronic enlargement and irritability of the prostate gland; and of a distended bladder from retention of urine. If, in connexion with these or similar symptoms, the patient occasionally voids small concretions composed principally of the phosphate of lime; the prostate is probably both enlarged, and contains such concretions in its ducts or cavities. When after the operation of sounding, catheterism, exposure to cold, &c., the patient experiences a severe rigor, followed by a sense of throbbing pain about the perineum, &c., increased by sitting, or evacuation from the bowels; with more or less of fever, and (after a time) complete retention of urine; acute inflammation of the prostate, is indicated. The same circumstance is indicated also, when in gonorrhœa the discharge suddenly ceases, and a train of symptoms, similar to those above recited, takes place. Moreover, in the last case, if frequent rigors and other symptoms of hectic supervene, we may generally expect that an abscess is forming; which may finally discharge itself into the urethra, or outwardly in the perineum, &c.

When, in cases of simple irritable bladder, there is no increased discharge of mucus, and the urine when just voided is transparent, it is probable that the irritability, which is usually temporary only, depends on the mere unnatural quantity or quality of the secretion: that is, the urine may be too dilute or too concentrated; too acid, or neutral, or alkaline; or contain some stimulating ingredient, &c. On the other hand, when cases of irritable bladder in young or middle-aged individuals are accompanied by pale-greenish, whey-like, turbid, and serous urine, of low specific gravity; where there is no mechanical impediment in passing the urine, but the frequent calls to void this secretion are accompanied by a sense of burning uneasiness, subsiding in general soon after the act of micturition, and referred, in males more especially, to that part of the canal lying in the perineum, and in females to the orifice of the urethra; when the general health of the patient, naturally perhaps feeble, gradually declines, and he begins to complain of a sense of weakness or uneasiness about the loins, accompanied by loss of appetite, &c., we may generally conclude that the cause of the irritability lies in the kidneys; that the bladder, at first only secondarily affected, is likewise becoming diseased; and that the patient will ultimately

sink under the affection. When, with all the above symptoms, there is a dark-coloured offensive bloody sanguis in the urine, and more or less of mechanical impediment in passing this secretion, there is reason to suspect the presence of incurable *fungus hæmatodes* in the bladder.*

When, in affections of the bladder, particularly in aged individuals, there is an acute pain in the region of that organ, extending in some cases to the urethra, at other times to the loins, testicles, and down the thighs, with a sense of constriction, conveying the feeling of a hard ball pressing on the rectum, &c., and preventing the egress of the faeces and urine; together with great restlessness, anxiety, cold perspirations, and tendency to syncope, &c., there is reason to suspect the presence of spasm of the bladder. It is difficult to distinguish spasm from inflammation in many instances, and sometimes the two affections are united; the following contrast of the symptoms, however, will generally assist us in our diagnosis. Cystitis, or inflammation of the bladder, is accompanied by all the symptoms of fever, while spasm is not. Pressure increases the pain of cystitis, but not of spasm. The pain is unceasing in inflammation, that of spasm comes on in paroxysms. The pain in cystitis is burning, throbbing, or lancinating; in spasm it is oppressive, dragging, and resembling labour pains. The constitution of the patient also should be taken into account. In the robust and sanguine, cystitis is the more probable disease; in the weak and nervous, spasm. These differences will rarely fail to direct us in well-marked cases; but when spasm and inflammation co-exist, which is often, as above mentioned, the case, it is always the safest plan to consider the affection as one of simple inflammation.

The symptoms of paralysis of the bladder are so strongly marked, that they can scarcely be mistaken. We pass on, there-

* The red particles of the blood discharged in the earlier stages of fungoid disease have often a remarkable appearance, and appear to the eye larger than natural; so that after they have subsided to the bottom of the urine, they at first sight somewhat resemble grains of lithic acid gravel, and, like that substance, when the vessel is inclined, may be distinctly seen to roll along the bottom. From this peculiar appearance of the red particles of the blood, the presence of malignant disease may be often suspected before the symptoms assume a decided character.

fore, to hysterical affections of the urinary organs, a set of diseases which tax our diagnostic skill to the utmost, and sometimes defy it altogether.

As hysteria is often as much a moral as a physical disease, to enable us to form a just estimate of many of the symptoms, it is absolutely necessary to take into account the moral history and character of the patient. These are delicate points of inquiry, and we must leave their investigation to the judgment and tact of the inquirer. Of the circumstances, independently of those of a moral kind, to be particularly attended to, the *age* of the patient is one of the most remarkable. Hysteria, strictly speaking, is generally limited to womanhood—to that interesting period of female existence, in which all the characteristic traits of the sex exist in their most susceptible and exalted state. We scarcely look for hysteria before puberty, and rarely see it in advanced life; or if the tendency to hysteria does continue to advanced life, we too often find that many of the derangements which in early life were merely functional, have, from long continuance, become confirmed diseases. Moreover, hysteria, in advanced life, (or something called by this name,) is too often connected with the abuse of cordial waters—in short, with the baneful habit of dram-drinking and its consequences.

Other points to be kept in view are the *rank* in life; and the degree, and kind of *education* of the patient. A poor unsophisticated country girl may be disappointed or betrayed, or otherwise cruelly treated, and her outraged feelings in consequence may vent themselves in genuine hysterical attacks; but the case is very different with the indolent, prurient, and sentimental novel reader. Here, whatever may be the cause of the derangement, hysteria seldom assumes its *vulgar* form; but the form of some extraordinary, calamitous, and interesting affection, calculated at once to excite the wonder and the pity of the beholders. The patient has suppression or retention of urine; she may labour under all the symptoms of renal or of vesical calculus; the urine itself may be red, black, white, serous,—in short, anything but natural; and, as before observed, the deception, if deception it be, will be more complete and more difficult of detection, in proportion to the reading of the patient.

However painful it may be to recur to these circumstances, it

is absolutely necessary to be well acquainted with them, to enable us to form a correct diagnosis and prognosis in a great many affections connected with the urinary organs in females; and even with all our knowledge, and with the utmost care and circumspection we can bestow on the subject, we shall sometimes find ourselves outwitted. In females more advanced in years, as above stated, the diagnosis, as well as prognosis, in affections of the urinary organs, are in general more easy and certain: for the imaginings of youth too often become the sad realities of age.*

Treatment.—In discussing the treatment of the different diseases considered in the present chapter, we shall follow nearly the order in which they were described. According to this arrangement, we have, in the first place, to speak of inflammation of the bladder and its consequences.

In chronic inflammation of the mucous membrane of the bladder, or *catarrhus vesicæ*; as well as in the chronic enlargement or degeneration of the prostate gland, very active measures are seldom requisite or proper; and indeed they often do more harm than good. In the earlier stages of both these affections, when the urine is high-coloured and strongly acid, and when there is obvious congestion about the hæmorrhoidal and abdominal system in general, the abstraction of blood by the application of leeches about the anus, or by cupping in the perineum, &c., is often useful as a preliminary step. With these remedies also may be conjoined active purgatives, of which calomel should form one of the ingredients. Indeed, the occasional use of gentle alteratives and purgatives will in general, in all the early stages of the affection, be found to be serviceable, and even necessary. In the confirmed

* In making these remarks, I am most anxious not to be misunderstood. Nothing can be further from my wishes and intention than the design to convey an impression derogatory to the female character. In hysterical cases, both the mind and body are really in a morbid state, and the patient can scarcely be regarded in the light of an accountable being. The striking peculiarity in such a state of the system consists in that extraordinary relation between the mental and bodily powers of the patient, which enables her, as it were by a mere act of volition, to determine a certain degree of functional derangement into any part of the body, or organ, her morbid fancy may intimate.

and passive stages of these affections, the remedies mentioned, at least the abstraction of blood, are seldom required. Various counter-stimuli, as issues, setons, blisters to the perineum, loins, thighs, &c., have been recommended in the chronic stages of these affections; but they are of little use. Nor in these stages of the affection is much gained by purgatives, beyond merely keeping open the bowels; indeed, active purging, by saline or by other injudicious remedies, seldom fails to aggravate the chronic stages, both of *catarrhus vesicæ*, as well as of chronic enlargement of the prostate gland.

The diet in these affections should be light and easy of digestion, and free from stimulating condiments; and the patient should either altogether abstain from, or very much diminish, the quantity of fermented liquors. Moderate exercise will be proper; but exercise on horseback, or in a rough carriage, or, in short, fatigue of any sort, should be avoided. During winter, and in cold and damp weather, the patient should carefully protect himself, as much as possible, from their influence; and if his circumstances admit, he may be even recommended to pass the winter months in a warmer climate. After these general remarks, we have to consider the remedies supposed to act specifically on mucous membranes, and hypertrophies.

The three great classes of remedies most generally beneficial in chronic affections of the mucous membranes of the urinary organs, are those of the balsamic, astringent, and sedative kinds; either of which may be given alone, or variously associated with the others, according to the circumstances of the case, or the judgment of the practitioner. Among remedies of the balsamic class, the mildest, as well perhaps as one of the most efficient, is the *diosma*. Next in order, follow the Tolu and Peruvian balsams; the Chian turpentine, copaiba, cubeb, &c.; all of which, judiciously administered in small doses, are often beneficial in chronic affections of the mucous membrane of the urinary organs. Of remedies of a tonic and astringent character, the *pareira brava*, an old remedy re-introduced by Sir B. Brodie, is undoubtedly one of the best we possess in catarrhal affections of the bladder. Next to this rank the *uva ursi*, and the *lythrum salicaria*. These last, however, are more especially beneficial in those forms and stages of the affection marked by irritative excitement, rather than by vascular

activity, or by organic disease. Hence they are of very little use when the irritation borders on inflammatory action on the one hand ; or when the urine is decidedly alkaline, on the other ; and their beneficial effects are chiefly confined to the intermediate stages of disease. Of sedatives, it is difficult to speak in a decided manner, as so much depends, respecting their use, on the idiosyncrasy of the patient. The irritation of mucous membranes in general, and particularly the irritation of the mucous membrane of the bladder, &c., seems to be less under the local and direct influence of sedatives, than pain or irritation in many other parts. Hence we can seldom do much towards allaying the irritation of the mucous membrane of the bladder, without bringing the whole system under the influence of narcotics. In the milder cases, henbane, conium, or lettuce, or various combinations of these, may be resorted to ; the compound tincture of camphor also, is an excellent preparation in many of these affections. When these fail, recourse must be had to opium, or to some of its preparations. Of these, the Dover's powder is one of the mildest. Next in order may be mentioned the watery extract of opium, Battley's sedative solution, tincture of opium, crude opium, &c. Then follow the preparations of morphia ; of which the most congenial and mildest appears to be the meconiate of morphia ; and the most efficient as well as the least injurious, with reference to its powers, the muriate of morphia. The acetate of morphia I consider, in general, not only more injurious to the nervous system, but inferior to the muriate, in point of sedative power. Yet there are some individuals with whom the muriate of morphia disagrees, but who can bear the acetate. I mention, once for all, the different sedatives, and in the usual order of their powers ; but I need not say, that owing to the idiosyncrasy of individuals, general rules respecting their use cannot be laid down in a satisfactory manner ; and in fact, it is only by experience that we can know what sedative agrees best with an individual ; or whether he can tolerate any. Lastly, with respect to the operation of narcotics, it may be stated, that different morbid sensations are very differently controlled by them. Simple pains, or aches, or smartings, or irritations, are in general, *ceteris paribus*, amenable to the operation of narcotics, nearly in the order in which they are stated ; but there is one form of sensation, or pain, of irritation,

or whatever we may call it, connected with affections of the neck of the bladder, and particularly with certain conditions of the mucous membrane of the organ, and which the patient describes as a sensation of *burning smarting heat*, that is less under the control of sedatives than any other; and indeed can scarcely be subdued without suspending or destroying the sensibility and consciousness of the patient altogether.

After these separate remarks on the three great classes of medicinal agents most usually employed in chronic affections of the mucous membrane of the bladder; we may observe that their good effects are often much increased by judicious combination. It is impossible to lay down rules for all cases, but the following hints may not be deemed irrelevant. The effects of balsamic remedies are sometimes more decided when conjoined with each other. Thus the infusion of diosma may be often advantageously associated with small quantities of the Chian turpentine, or cubebs, or even copaiba; which may be given in the form of pills, with the extract of henbane, conium, hop, &c. If gouty irritation or hepatic congestion be present, the acetous extract of colchicum, combined with some mild mercurial, may be also administered at the same time with the above. Balsamic and astringent remedies may be sometimes conjoined; but as these two classes of remedies seem to be indicated in different stages or modifications of disease, their conjoint operation can be seldom required. Sedatives are commonly necessary in every combination, in some shape or other. In the earlier stages of the affection, when the urine is acid, alkalies may be often employed in conjunction with the other remedies; while in the latter stages, when the urine is alkaline, the mineral acids often prove serviceable. Finally, demulcent diluents, as barley or gum water, linseed or marshmallow tea, rennet whey, &c., may be used in moderation with advantage.

Acute inflammation of the bladder, of a phlogistic kind, in young and plethoric subjects, requires prompt and decided measures. Bloodletting from the arm, (some of the French surgeons recommend bleeding from the foot in preference,) to be repeated according to circumstances, accompanied by local bleeding by cupping or leeches, from the region of the pubes, and especially from the perineum, should be resorted to as speedily as possible.

These means may be followed by warm fomentations, or the warm bath, the injection of emollient fluids into the rectum, &c. Internally, active doses of calomel, conjoined with opium, may be exhibited; and the bowels may be relieved by laxative clysters. After the more urgent symptoms have been subdued, various counter-stimuli may be applied to contiguous regions; but if blisters be employed, they should be withdrawn early, and such dressings be subsequently applied as may tend to promote their effects. Retention of urine, if present, of course must be obviated by the catheter; but, during the more acute symptoms, it will be proper to be as sparing as possible in the use of instruments. The chronic inflammation or irritation of the mucous membrane of the bladder, too apt to follow acute attacks of that organ, must be combated by the means recommended for that purpose in the preceding paragraph.

General inflammation of the bladder, attacking more especially the cellular substratum of that organ and its neighbourhood, commonly bids defiance to our utmost skill. Here, even from the outset, antiphlogistic remedies are almost entirely out of the question; and the utmost we can hope to effect, is to mitigate, as well as we are able, the sufferings of the patient; and to support the fast ebbing powers of life by nutritious diet and stimulating cordials.

The treatment of chronic degeneration and enlargement of the prostate gland falls almost entirely within the province of the surgeon. In the more passive conditions of the affection, antiphlogistic means are neither indicated nor useful. The use of sedatives is sometimes beneficial; and in those cases in which complete retention of urine occasionally takes place, probably in some degree from spasm, a decided dose of opium will sometimes promote the discharge of urine. When the retention of urine is complete, and permanent, relief can be only obtained by the catheter.

The treatment of prostatal concretions, also, is for the most part of a mechanical nature, and therefore belongs to the surgeon; there being no known medicinal means by which we may hope either to prevent their formation or increase. Mr. Wilson observes, "If these calculi be not very troublesome, our best plan will be to leave them alone, and not to irritate the gland

by the introduction of the catheter more frequently than may be necessary to prevent retention of urine. When very troublesome, and when they can be felt through the rectum, they may be cut out by an incision, as in the old method of cutting for the stone, or the *gripe*, as it was called; but what I should conceive to be the safer practice, they may be extracted by an incision into the gland, from the perinæum.* In some of these cases, they may be withdrawn by Weiss's forceps—a method of removing them which I have seen successfully practised by Sir B. Brodie in considerable numbers.

Acute inflammation of the prostate must be treated much the same as acute inflammation of the bladder. Cupping over the loins, or in the perinæum; or the application of numerous leeches about the perinæum and anus, often affords relief, and checks the more urgent symptoms. With these may be employed warm fomentations, or poultices to the perinæum, the warm bath, &c. The bowels should be kept open by mild aperients or clysters; and those purgatives likely to irritate the rectum should be particularly avoided. In the earlier stages of the disease, the use of instruments should be abstained from as much as possible. When the more active symptoms have subsided, relief is sometimes obtained by the judicious use of sedatives; which may be employed either internally, or injected into the rectum; and in this state of the affection, if the catheter can be introduced without irritation, its use may be beneficial. The management of abscesses and other severe consequences of acute inflammation of the prostate, belongs to the surgeon.

The treatment of the second great division of bladder and prostate diseases, namely, those of an *irritable* kind, comes in the next place to be considered. Cases of irritation of the bladder, depending on mere derangements of the assimilating functions, and on the unnatural properties of the urine resulting from indigestion, &c., are generally of a temporary character, at least in their earlier stages; and are removable by adjusting these functions. These points have been already so often discussed, and are so well understood, that we need not dwell on them here. We shall only, therefore, repeat the important caution,

* Lectures on the Urinary Organs, page 356.

namely, that dyspeptic individuals ought to be particularly observant with respect to diet, &c., lest they render temporary affections permanent, and thus lay the foundation of serious urinary disease.

The treatment of irritable bladder depending on renal affections is difficult, and too often unsuccessful. The simplest form of the primary disease, which appears to constitute the basis of all the more unmanageable varieties of this class of affections, may be aggravated by injudicious remedies, but scarcely seems capable of being much benefited by any. Great care and attention will sometimes enable us to arrest the affection for a while, perhaps for years; but in every instance, in which I have hitherto had an opportunity of observing its progress during a lengthened period, I have seen it terminate unfavourably in some form or other.

The first points to be attended to, are the strictest attention to diet and regimen. The patient must consider himself an invalid, and live carefully according to the rules laid down for him. He should avoid all stimulating and indigestible articles of food, and adopt a simple, light, and nutritious plan of diet. Exercise must be taken, but it must be of a gentle kind; and long journeys in rough carriages, and fatigue and exertion of every kind, are calculated to aggravate the affection, and must be most carefully avoided. When practicable, sea voyages, and residence in a warm climate during the winter, may be recommended.*

The different forms and stages of these affections require modes of treatment somewhat different; and from idiosyncrasy and other causes, the remedies which seem best adapted to the affection can often neither be borne at all, or be borne long enough to give the requisite chance of doing good. The following is a brief sketch of the remedies and modes of treatment I have found most beneficial in these affections.

In the early stages of the affection, if there be anything like activity, a few ounces of blood may be abstracted by cupping from the loins, or by leeches applied to the perineum. At the same time, the citrate of ammonia may be given internally in conjunc-

* The reader is more especially referred to the chapter on serous urine, for the detailed account of the treatment of anæmotrophic affections of the kidney nearly allied to the present affections. See page 157, et seq.

tion with mild but efficient purgatives. In general, however, the abstraction of blood is seldom necessary, or at least, I have rarely seen patients who have required depletion. In these stages of the affection when quiescent, the *uva ursi*, the *lythrum salicaria*, the *pareira brava*, and even small doses of chalybeates, as of the citrate of iron, or of the *tinct. ferri muriatis*, are sometimes useful; particularly if so directed or combined as to improve the health in general, as well as the local affection. In the more advanced stages of the affection, in which the urine has become decidedly serous, of low specific gravity, and has a tendency to alkalescence, remedies of the above character seldom do much good, and, indeed, if administered in a decided form, they appear sometimes to increase the irritation. In these stages of the affection, if accompanied by permanent excitement, the citrate of ammonia, either alone or combined with the fluid extract of sarsaparilla, may be given; if quite passive, the *infusum diosmæ*, with the extract of sarsaparilla, or the dilute muriatic acid, are very excellent remedies; indeed, I have seen more benefit derived from these expedients, and the judicious use of sedatives, than from any other means whatever. Other remedies of the balsamic class in small doses are sometimes beneficial, and their use may be associated or alternated with the *infus. diosmæ*; such as the *tinct benzoini comp.*, the infusion of the wild carrot seed, or of sassafras, &c. All these, however, must be so administered as never to excite; and the *weak state* in which it is necessary to give them, must be compensated for by the *length of time* during which they are taken. In conjunction with these means, an issue or seton may be instituted over the region of the kidneys; but in general, in diseases of the present description, the excitement and worry produced by this class of remedies is hardly compensated for by the little benefit they produce. In the last stages of the disease, beyond general remedies, I know nothing that can be directed to the local disease with any prospect of advantage; and the utmost we can hope to accomplish is to alleviate the sufferings of the patient by sedatives; of which, perhaps, the muriate of morphia, with hyoscyamus or conium, are among the most efficient.

When irritation from disease about the orifice of the urethra exists in females, it must be obviated as far as possible by local expedients—a point, in general, that can be only accomplished by

the application of stimuli calculated to permanently destroy the morbid sensibility of the part; and when this has been accomplished, the progress of the general affection seems to be occasionally arrested, and the sufferings of the patient for a time will be very much relieved.

With respect to the treatment of *ulceration, polypous excrescences, elongations of the lining membrane of the bladder, enlargement of the prostate*, and a variety of other similar chronic affections giving occasion to irritable bladder, it is impossible to lay down any specific plan; but in the management of all of them the maxim should be borne in mind, that it is much easier to do mischief than to do good. The general principles of treatment likewise, stated in the preceding paragraphs, should be kept in view; and the remedies there enumerated be so administered, on the one hand, as to moderate activity; and on the other, to mitigate the sufferings and support the general health of the patient; and these, joined with such local assistance as an experienced surgeon knows how to administer, will sometimes enable a patient to bear up under his sufferings, and ultimately to arrive at comparative comfort. At any rate, they constitute the whole that, in his deplorable state, can be effected for him by human aid. Nearly the same remarks may be made respecting the treatment of *fungus hæmatodes*. Here, nothing can be done towards the *cure* of the patient; and all we can reasonably hope to effect is, to allay in some degree his sufferings by sedatives; and to prolong his existence by checking and obviating the consequences of that fearful hæmorrhage which too often accompanies this affection,—a subject we shall briefly notice in the next chapter, when we come to speak more particularly of hæmorrhage from the urinary organs in general.

The treatment of those cases of irritable bladder depending on chronic thickening and contraction of the organ; or on enlargement of the prostate, stricture of the urethra or other affections, of a mechanical nature, belongs almost exclusively to the surgeon. As a remedy, the use of iodine, both internally and externally, has been strongly recommended when the prostate has been enlarged and the bladder thickened; but I know not with what result. I have repeatedly seen the remedy tried in these affections, but cannot say that I have been sensible of any improvement from its use.

Gouty irritation of the urethra usually resists the use of balsamic remedies, but readily yields to colchicum, and to the treatment adapted for gout in general. Rheumatic gouty irritation of this canal is much more obstinate; and in short, like rheumatic gout in other parts, commonly defies for a long time all our efforts to conquer it. Colehieum is of very little use; and the affection is best treated with Dover's powder, or other preparations of a sedative kind, with the view of allaying the irritation. I have sometimes seen benefit derived from guaiacum; but in other instances this remedy has failed; as has also the hydrionate of potash; which appears to be one of the best remedies we possess for that peculiar affection apparently nearly allied to rheumatic gout, which sometimes attends, or follows, common gonorrhœa.*

Cases of irritable bladder depending on affections of the nervous system are manageable or otherwise according to the nature of the nervous affection. If the nervous affection be simply of the constitutional kind, the irritability may be merely the result of habit; and in this case, a little well-directed resolution on the part of the patient, aided by appropriate medicines, will enable him to conquer the irritability; or at least to prevent it from becoming permanent. On the other hand, if the cause be organic lesion of the brain, as is sometimes the case in aged individuals; little, as Sir B. Brodie justly observes, can be done towards the patient's relief, and the cerebral disease will ultimately prove fatal.

The treatment of spasmodyc affections of the bladder will be considerably modified according to their cause. If the spasm depends on the presence of stone, stricture, or any other cause of a mechanical nature, this must be removed, or the effects obviated as soon as possible. If inflammation be present or threatened, cupping or leeches over the loins, or about the anus or perineum, followed by the warm bath or fomentations, will be proper. With these remedies, opiates either taken into the stomach combined with calomel, &c., or applied locally in the form of suppository or injection, may be administered with advantage. If the spasm be of a gouty nature, mustard or other stimulating cataplasms may be applied to the feet; or to any other part of the extremi-

* See Mr. Lawrence's paper, before referred to, p. 390.

ties the gout may have recently left, or formerly been in the habit of attacking. When spasm of the bladder causes retention of urine, and inflammatory symptoms are absent, the muriated tincture of iron, repeatedly given in small doses, as recommended by the late Mr. Cline, will sometimes remove the affection. In spasmodic affections of the bladder, of a purely nervous or hysterical character, different tonics associated with camphor, musk, valerian, and other remedies of a reputed antispasmodic character, may be sometimes employed with advantage.

The first point to be attended to in the treatment of paralysis of the bladder, is the prevention of an accumulation of urine in that organ. This accident must be obviated, at any rate, by the judicious use of the catheter; while the rest of the treatment will very much depend upon the general nature and cause of the affection. When the paralysis is connected with spinal or other deep-seated disease, little for the most part can be accomplished. Nevertheless, in some of the more favourable of these cases, the judicious use of stimuli, as electricity or galvanism, the tincture of cantharides, &c., may be worth a careful trial. In the still milder forms of the affection, in young and middle-aged individuals, depending on general debility of the system, the cold bath and other invigorating expedients and remedies offer a prospect of relief. When the complaint is purely local and passive; in conjunction with the above means, some of the continental writers have recommended the injection of cold water into the bladder or rectum; and this expedient, as well as others calculated to ensure the bracing effects of cold without the sedative operation, may be resorted to.

It remains, in the last place, to make a few remarks on the treatment of hysterical affections of the urinary organs. The first great point to be attained in hysterical affections, is the difficult one of an accurate diagnosis. We must make sure that the affection we have to combat is hysteria, and *nothing but hysteria*. For it should be always borne in mind, that in irritable habits, and especially in females disposed to hysteria, a *very slight cause*, such as a small stone in the bladder, &c., will often produce very great suffering; and that in such cases, though the hysterical symptoms may predominate, and render doubtful or conceal the original character of the excit-

ing cause, the affection is nevertheless of a mixed character; and that the hysterical part of the affection will probably cease, when such exciting cause has been removed. Moreover, we should bear in mind, that what was at first merely a functional, may, by long continuance, become a real or organic, disease. As an instance in illustration of this remark, we may mention the retention of urine which sometimes occurs in hysterical females. In the earlier stages of the affection, hysterical retention of urine is almost always a purely functional disease, and the patient retains the power of emptying the bladder, provided she be forced to exert the *will*. "As the distension of the bladder increases," says Sir B. Brodie, "the patient begins to get uneasy, and at last suffers actual pain; and as soon as this happens, the volition is exercised as usual, and the bladder begins to dispel its contents.* Hence Sir B. Brodie very properly goes on to observe, that if the bladder be not relieved artificially by the introduction of the catheter, the hysterical retention of urine is usually of short duration; but if the catheter be had recourse to, the natural cure is prevented, and the existence of the disease may be prolonged for an indefinite length of time—for weeks or even for months. The general rule, therefore, in such cases, is to interfere but little. An active aperient may be given, or an assafœtida enema, &c., may be administered, but the use of the catheter should not be resorted to. Yet, as observed by the same author, cases of hysterical affection may arise, in which the bladder by over-extension may have become paralysed and unable to expel its contents, and in which consequently the use of the catheter is absolutely necessary. The same remarks are applicable to other affections, besides retention of urine. Thus pains in the back, for instance, may come in time to denote spinal or psoas disease; the functional derangements of the kidney may terminate in organic affection; or in calculus, &c. In short, as we have elsewhere observed, we never should make light of a case in which the symptoms have been of a severe kind and of long duration; how much soever it may partake of the hysterical character.

* *Lectures on the Urinary Organs*, page 99, third edition.

CHAPTER V.

OF HÆMORRHAGE FROM THE URINARY ORGANS IN GENERAL.

THE obvious nature of Hæmaturia renders a description of the affection unnecessary. The little, therefore, we have to say on the different forms and circumstances under which blood appears in the urine, will be considered under the heads of the causes, diagnosis, prognosis, and treatment of the affection.

The general or predisposing causes, as well as the sources of hæmorrhage from the urinary organs, may be various, and are often very obscure. In certain epidemics of the malignant type, as for instance, in cholera;* in severe remittent or typhoid fevers, arising from, or modified by, malarious influence; or in affections of the spleen and liver produced by the same cause; also in scurvy, &c.; the properties of the blood and of the vital solids, appear to undergo certain changes producing a tendency to hæmorrhage from all the outlets of the body, and from the kid-

* See page 21, where the tendency to hæmorrhage from the urinary organs after this disease is noticed. The reader also will find hæmaturia mentioned as a frequent symptom of many other diseases, both constitutional and local, besides those mentioned in the text; as, for instance, of chylous urine, hæmorrhoidal congestion, suppression of the catamenia in females, derangement of the bowels produced by the irritation of teething in children, &c. We also read of hæmaturia as an epidemic affection both in children and adults, in some countries and localities. In these instances, the constitutional symptoms and tendencies may be very different, and depend on very different causes; but in the epidemic varieties the cause is most probably of a general nature, and depends on unwholesome diet, or on some modification of malarious influence.

neys and bladder in particular. In such cases, although the hæmaturia is to be regarded as a mere symptom of a state of disease, the consideration of which falls without our present design; yet a thorough acquaintance with the pathology of such affections is often of the greatest importance in enabling us to form a correct diagnosis in hæmaturia; as will appear from the following observations on the subject.

The immediate or exciting cause of hæmaturia may be of a mechanical nature, that is, a calculous concretion; or the cause, may consist in ulceration, healthy or malignant, of the kidney and bladder, or of their appendages. The chief points of diagnosis, therefore, in hæmaturia will be; first, the causes, predisposing or exciting; and secondly, the seat of the haemorrhage, whether in the kidney, or in the bladder. On each of these, we shall offer a few remarks.

The nature of some of the predisposing causes of hæmaturia is so obvious from the history and symptoms, that their true character can be hardly mistaken; such, for instance, are typhus, scurvy, &c. The effects of malarious influence as a predisposing cause are much more obscure; and their nature can, in many instances, be only made out by a minute and careful investigation of the patient's history, and sometimes not at all. This arises no less from the multiform degrees and shapes assumed by this fearful scourge in different seasons and climates; than from the very different effects they produce on different individuals, from idiosyncrasy; &c.—circumstances which, in conjunction with many others of a similar kind, render it almost impossible to form a just estimate of how much of the effect is due to the predisposing, and how much to the exciting, cause of the haemorrhage. Moreover, the difficulty is still further increased by the fact, that when the predisposing causes are unusually active, either in virtue of their own powers, or from the idiosyncrasy of the patient; a very trifling exciting cause that would not produce the least haemorrhage in a healthy individual, as for instance, a very small renal concretion, may, in such a strongly-predisposed habit, give occasion to very severe haemorrhage.

When the haemorrhage cannot be traced to any of the constitutional or predisposing causes above mentioned, we must seek for its origin among those causes more immediately of a local or ex-

citing nature. These, as already stated, may be of two kinds. The immediate exciting cause of the hæmorrhage may be a calculus, which, without causing ulceration strictly so called, may have wounded some blood-vessel ; or the hæmorrhage may result from ulceration, which may or may not be produced or accompanied by a calculus, and may be either of a healthy or of a malignant character. To state precisely on which of these circumstances the hæmorrhage depends, or with which it is connected, is not always an easy task ; though the following circumstances may enable us to form an opinion on the subject.

If the hæmorrhage occurs more particularly after exercise, and if the blood be either florid or dark-coloured, and mixed with lithic acid ; or if the urine abounds or has long abounded in this principle, and the patient has occasionally passed lithic acid gravel or concretions ; if there be more or less of pain accompanying the hæmorrhage ; if the patient be under the age of puberty, or of middle or advanced age, the immediate cause of the hæmorrhage will almost certainly prove to be a lithic acid concretion. On the other hand, when the hæmorrhage, as before, particularly occurs after exercise, and the blood is of a very dark colour, or like coffee grounds, and *unmixed with lithic acid* ; when the urine is of a greenish citron tint, and the patient has at no time of his life been subject to urinary sediments (of lithate of ammonia) ; when he has occasionally (or constantly) laboured under cutaneous eruptions, particularly of the scaly kind, and present the cachectic aspect formerly described as peculiarly marking the oxalic acid diathesis, the probability is very great, that the hæmorrhage is occasioned by a concretion of the mulberry variety ; which may or may not be associated at the same time with organic disease. Hæmorrhage, at least to much extent, is rarely produced by phosphatic concretions ; and when the circumstance occurs, the properties of the urine and the history of the patient seldom fail to lead to a correct diagnosis on the subject.

Ulceration in some portion of the urinary organs, is another great source of hæmaturia. Ulceration, as we have stated, may proceed from very various causes, and be very different in its character and consequences ; nor can we always satisfactorily determine either its cause or nature. The characters of the blood, and of the

matters accompanying it, usually afford us the surest means of diagnosis; and in most instances will enable us to approach the truth with tolerable certainty.

When the patient labours under no constitutional disease usually accompanied by hæmorrhage, or has not suffered from calculous affections of any description; when he complains of pain in the urinary organs and voids blood with the urine, and the blood is mixed with mucus, and particularly with purulent matter, a breach of surface must exist somewhere; and there is certainly either actual or incipient ulceration in some portion of the urinary apparatus. If the blood, mucus, or pus, present no remarkable appearance or offensive character; we have reason to hope that the ulceration is of a common or favourable kind; but if the blood be very dark coloured, and associated with unnatural matters of a highly offensive, and particularly of a putrid odour, the ulceration very probably partakes of a malignant nature, and will prove fatal.

Having ascertained, as far as we are able, the *cause* of the hæmorrhage, the next point is to determine its *seat*—a circumstance often intimately connected with the cause, and sometimes of equally great importance.

When urinary calculi have been known to descend from the kidney, and there is a sense of heat, weight, and pain, in the region of that organ; when the pain darts to the end of the urethra or testicles, and there is more or less of nausea and vomiting, the hæmorrhage, in general, may be reasonably supposed to depend on the presence of a calculus in the kidney or ureter. On the other hand, when the hæmorrhage comes on after exercise, and there is occasional retention, or sudden stoppage, of urine accompanied by a sensation referred to the end of the penis; when a similar sensation is felt at the same place, at the moment the bladder is emptied, there can be little doubt that the bladder is the seat of the hæmorrhage, and that the cause is a stone in that organ.

When the symptoms accompanying the hæmorrhage are equivocal, and when those above mentioned in particular, are wanting, which usually indicate the presence of stone in the kidney or bladder; our attention must be more immediately directed to the character of the blood, and to the circumstances under which

it makes its appearance in the urine. When blood enters the bladder from the kidney, it is generally more or less equally diffused throughout the whole urine voided ; and if the quantity of the blood has been considerable, coagulation takes place in the ureters, producing suppression of urine, and violent pain and vomiting, &c. When such symptoms are present, and when some time afterwards we see in the urine elongated masses of fibrin resembling worms, which had been moulded in the ureters, the source of the blood is unequivocally the kidneys. On the other hand, (supposing the patient to have been previously quiescent,) when the first portions of urine flow away nearly clear, and the great mass of the blood comes away at the end of the process of micturition ; and when all the symptoms usually accompanying renal irritation are likewise absent ; there can be little doubt in general that the source of the haemorrhage is in the bladder.

Further, the quantity of blood passed down from the kidney is seldom so large as to fill the bladder, and by its coagulation to cause retention of urine ; when, therefore, the bladder becomes distended with coagulated blood, and retention of urine in consequence takes place, we may almost certainly conclude that the haemorrhage has taken place in the bladder itself. When the blood flows away *guttatum* without the urine, it may be supposed to come from some part of the urethra. In this case, however, if the source of the haemorrhage be very near the neck of the bladder, the blood occasionally makes its way backwards into the bladder, and thus produces some uncertainty as to its origin. Lastly, the phenomena presented by the blood itself, sometimes throw light on the nature, as well as the origin of the disease ; as for instance, in *fungus hematodes*.*

We have mentioned one of the formidable consequences sometimes resulting from profuse haemorrhage into the bladder, namely, the coagulation of a large mass of blood in that organ, and the consequent retention of urine occasioned by the coagulum. Another unpleasant consequence of the presence of blood in any part of the urinary apparatus, to which the urine has access, is the formation of a nucleus around

* See note p. 400.

which calculous matter may at some future time concretate. Hæmorrhage from the urinary organs, therefore, though not caused by a calculus, may of itself prove a cause of calculus hereafter.

After what has been stated, we need not dwell on the prognosis in hæmaturia, which will be favourable or unfavourable according to its origin and degree; and according as its cause can be removed or otherwise. The loss of blood from the urinary organs is seldom so large as to destroy life at once; yet when the cause is with difficulty removable, from the little control we sometimes have over the affection, the daily loss of blood is liable to produce serious inroads on the system; and once or twice I have seen it prove fatal.*

The *treatment* of hæmaturia will depend on its cause, and on its degree and seat. Hæmaturia, when of a constitutional character, and occurring in a young or plethoric subject, and when it appears to be vicarious to hæmorrhoidal or catamenial discharges; when accompanied also by a full and strong pulse, and more or less of inflammatory excitement, will sometimes require general or local abstraction of blood, and the usual antiphlogistic treatment. Such cases, however, are rare; at least, they seldom come under the care of medical men in this stage; and the affection, constitutionally speaking, is usually accompanied by some cachexia, or disease, of which debility is a leading feature; such is scurvy, typhus fever, &c. Even those affections of the liver and spleen, produced by malaria,

* The circumstances attending one of these cases were remarkable. The patient had been long resident in a notoriously malarious situation. At length he became subject to hæmaturia, which, in spite of every remedy, continued more or less, if I remember rightly, for about two years. I saw him a short time before his death, in a state of perfect anæmia, and beyond a hope of recovery. After death, a mulberry calculus was found in one of the kidneys, which was probably the immediate cause of some portion of the hæmorrhage. The greater part of the blood, however, appeared to have come from a spot about the size of a crown-piece, in the upper and posterior part of the bladder. The surface of the organ was not apparently diseased in this spot; but the blood obviously transuded through the mucous membrane, from a large plexus of veins distended with dark-coloured blood, and situated immediately behind this portion of the bladder.

and accompanied by a hæmorrhagic tendency, often belong to the same class; at least they seldom bear or require general depletion.

The treatment of fevers, scurvy, &c., in which hæmaturia is rather to be viewed as a symptom, than as a disease, does not fail to be considered in this place; and the only affections of a constitutional character to be noticed, are those obscure forms of disease, most usually of malarious or gouty origin, in which hæmaturia apparently constitutes the chief affection to be combated. In hæmaturia decidedly connected with affections of malarious origin, the mineral acids, conjoined with quinine, gallic acid, matico, the *tinct. ferri muriatis*, alum, and other remedies of this class, are generally found to be the most efficient. When the milder and safer remedies fail, we may resort to those of a more powerful character, as arsenic, zinc, or lead; and of all other remedies, when the hæmorrhage takes place from the kidney, the acetate of lead is perhaps the most efficient. In conjunction with the above remedies, when the liver, and particularly the spleen, as is often the case, is congested and tender, the occasional application of a few leeches to the part, in conjunction with the preceding treatment, appears to be beneficial; at any rate, such application enables us to push our tonic and astringent remedies with the greater confidence. Some of these cases, however, resist for a long time every means we can employ, and will at length cease spontaneously. In other instances, they go on to a fatal termination. I have seen one or two instances only, of the latter kind; but during the period just subsequent to that in which the cholera prevailed in London, I saw a great many cases in which the hæmorrhage from the kidneys remained most profuse and constant, in spite of every remedy, for many weeks together; but at length ceased of its own accord, and without leaving any unfavourable result.*

When renal hæmaturia is connected with a gouty diathesis, colchicum may be sometimes advantageously joined with the ap-

* Except, perhaps, in a few instances, the formation of a nucleus around which an oxalate of lime concretion was subsequently deposited. For, as already observed, the oxalic acid diathesis prevailed in a remarkable degree at this period. See page 20, et seq.

properite styptic remedies. In such cases also, the carbonate of soda may be often given with good effect *after* meals; while the mineral acids, &c., are taken at other times of the day. In ordinary cases of renal haemorrhage, when there are no symptoms either of excitement or debility, and when the cause appears to be of a mechanical nature, small doses of balsamic and of terebinthinc remedies, as copaiba, or turpentine, have been much recommended by some writers. I have often resorted to this class of remedies, but am sorry to say that I have been generally disappointed in their effects.* If the mechanical cause of the haemorrhage be a small calculus, we may endeavour to dislodge it from the kidney by the appropriate means, and thus remove the affection permanently; but if from the symptoms and properties of the urine, there be reason to fear that the concretion is too large to be removed, all such attempts shquld be carefully avoided.

When the bladder is the source of the hæmaturia, the cause, as before, may be various. In plethoric individuals of middle and advanced age, it is often connected with an haemorrhoidal tendency and enlarged prostate, and the haemorrhage is apt to take place periodically. In such cases cupping over the loins, or leeches to the perinæum and anus, will be useful. Should the immediate cause of the haemorrhage be even a stone in the bladder, before an attempt be made to remove the calculus, the same means may be employed; provided the same state of congestion exists. In haemorrhage from the bladder of a more passive character, and connected with malarious influence, the constitutional remedies adapted for such a state of the system, conjoined with the use of the various styptic remedies above mentioned, may be resorted to.

When the bladder becomes distended with blood, and complete retention of urine in consequence takes place, recourse must be had to a large-eyed catheter, and an exhausting syringe, by the aid of which, and the occasional injection of cold water,

* In some of these cases, the most efficient mode of exhibiting this class of remedies is to combine them (e. g. 3ij. vel 3ij. of the oil of turpentine) with castor oil or other purgatives. This is an excellent remedy in haemorrhagic tendencies connected with certain forms of splenetic derangement arising from malarious tendency.

the coagula may be broken down and removed. If the hæmorrhage be so profuse, that the bladder becomes again distended with blood in a very short time, the injection of cold water into the rectum or bladder is sometimes of great use; and should these means fail, from twenty to forty grains of alum may be dissolved in each pint of water injected into the bladder, a remedy that seldom fails to check the bleeding, even when the cause is malignant disease. I have never known any unpleasant consequences follow the use of this expedient; and have seen it immediately arrest the most formidable hæmorrhage, when all other means had failed; and when the bladder had repeatedly become again distended with blood, almost immediately after its removal.

CHAPTER VI.

OF SUPPRESSION, RETENTION, AND INCONTINENCE OF URINE.

Suppression, retention, and incontinence of urine most usually appear as symptoms of other diseases ; and in this character they have been repeatedly noticed in the preceding pages. It may not be amiss, however, for the sake of reviewing and concentrating what has been said on those subjects, to briefly consider them as idiopathic affections.

In *suppression* of urine, or *ischuria renalis*, the functions of the kidneys are more or less suspended or destroyed, and the urine ceases to be separated. In *retention* of urine, or *ischuria vesicalis*, the kidneys perform their office as usual, and the urine makes its way into the bladder ; but from some cause the secretion cannot be ejected from that organ. The symptoms attending these two affections are so different, that they can be hardly mistaken ; and in all doubtful cases, the nature of the affection can be readily determined by the introduction of a catheter into the bladder.

Of suppression of urine.—Suppression of urine may be partial or entire, and may depend on a variety of causes. The general characters of the affection, also, may be considered as of three kinds ; viz. inflammatory, spasmotic, and mechanical ; and the symptoms will vary somewhat according to the general character of the affection.* When suppression of urine is ac-

* We hear and read cases of suppression of urine taking place suddenly in advanced life, in individuals *apparently in perfect health*. I have seen no such instances ; and in every case of suppression of urine that has fallen under my own observation, there has been constitutional or local disease present, abundantly sufficient to account for the suppression. In such states of predisposition, exposure to cold, or gout, sometimes causes a rather sudden suppression of urine.

accompanied by, or depends on, inflammation of the kidneys, the symptoms will partake more or less of the character of those already described, as produced by that affection. When the signs of inflammation are absent, and the patient has been subject to gout; or if a female, to hysteria; the suppression may be supposed to depend, in part at least, on spasm. The presence of mechanical suppression may be suspected, when the person has been subject to calculous affections, &c. Generally, however, in this latter case, the effects cannot be ascribed altogether to the simple operation of the mechanical cause, but in part also to the inflammation or spasm, or both, to which the mechanical impediment is liable to give occasion; and the affection thus assumes a mixed character. When the suppression of urine is complete, the following constitutional symptoms are usually present:

The initial and earlier symptoms of suppression of urine, may vary, as above stated, according to the general characters of the affection; but when the suppression becomes confirmed and complete, all the minor distinctions are forgotten or overlooked amidst the severe suffering and imminent danger of the patient. The invasion of the affection is characterised by anxiety, restlessness, and an indescribable sense of uneasiness and distension, about the abdomen and loins. To these symptoms quickly succeed a peculiar expression of torpidity, and disinclination to exertion of any sort, bodily or mental. The stomach becomes more or less affected; there is usually a tendency to hic-cough or nausea; and the body exhales a urinous odour. The pulse in general is slower and feebler than natural; the patient scarcely complains; and gradually lapses into a state of drowsiness, with incoherent rambling. The drowsiness increases, and at length terminates in complete coma; in which state, sometimes after repeated attacks of convulsions, the patient expires.

Suppression of urine may take place at all ages, and in all the forms above mentioned, from the action of the requisite exciting causes. It most commonly occurs in children and in old people. When it takes place during the period of adolescence, particularly in females, it is almost always connected with hysteria. In children, the irritation and derangement arising from

dentition, is perhaps the most frequent concomitant or exciting circumstance of suppression of urine. In advanced age the affection is usually connected with gout, gravel, or nephritic disease; and the immediate exciting cause is most usually exposure to cold.

Suppression of urine, when complete, and of an original character, or supervening on any acute disease, for the most part proves fatal. But there are many extraordinary cases on record, in which, in suppression of urine, a vicarious discharge, more or less resembling urine, has taken place by sweating, vomiting, stool, &c., and the patient under these circumstances has sometimes survived for a long time, and even ultimately recovered. Most of these cases have been said to occur in females, and therefore have doubtless been of an hysterical character—a circumstance which throws a strong suspicion over their authenticity, and which renders it probable that the suppression and vicarious discharges of urine, in some of these instances, have been feigned. I have seen a few such cases, in which the imposition, after having been practised for months, has been at length detected; and the display of ingenuity and cunning, which has come to light on one or two of these occasions, has been almost surpassing belief.*

* When the suppression of urine is *complete*, coma almost invariably becomes established before the end of the fifth day; a complete suppression of urine, therefore, is obviously incompatible with life. It is surprising, however, what relief appears to be afforded to the system by the occasional passage of *a small quantity of urine*, and it is probable that some of the extraordinary cases of pretended suppression of urine on record, are referable to this principle. In other instances, the apparent absence of urine may have been connected with some unusual termination of the ureters, or of the bladder; as for instance, into the rectum, &c. As for the alleged vicarious discharges of urine by the stomach, nipples, ear, &c., they are too marvellous to be true. I have seen repeated instances of pretended vomiting of urine, and have examined the fluid, and found it in some cases to closely resemble that secretion; but in all such cases the patient, on being narrowly watched, had been observed to practise the deception of voiding and immediately swallowing the urine! In other instances, the fluids brought to me as urinous discharges from the stomach, have proved on examination to be altogether different from that secretion.

Suppression of urine, occurring as a symptom, has been already referred to in many parts of this volume. I do not think it necessary, therefore, to enter into details on the mode of treatment; but shall content myself with the following general remarks on the subject. The treatment of suppression of urine will depend chiefly on its causes, and on the nature of the symptoms with which it is associated. When combined with inflammation of the kidney, the active antiphlogistic means pointed out for the treatment of that affection must be resorted to. When the suppression is of a spasmodic character, the chief reliance will be placed on antispasmodic remedies, conjoined, in chronic or partial forms of the affection, with diuretics or tonics; or if associated with gout, stimulating cataplasms may be applied to the feet, &c. When evidently connected with a mechanical cause, as calculus, &c., recourse must be had to the means recommended in such affections; and, at the same time, care must be taken to keep down, as much as possible, the more active symptoms of inflammation, &c.

Of Retention of urine. In retention of urine, there is more or less of pain and uneasiness in the region of the bladder, accompanied for the most part, in the earlier stages at least, by an urgent desire to pass off the urine. The distended bladder, also, forms in most instances a swelling above the pubes, not only perceptible to the touch, but sometimes even to the eye; and the drawing off of the urine by the catheter, if this can be effected, always gives great and immediate relief to the patient's sufferings.

The different circumstances under which retention of urine takes place, have been noticed in the preceding pages; and it only remains to remind the reader here, that the cause of the retention may be inflammation, spasm, or mechanical obstruction at the neck of the bladder, or in the urethra; or a combination of these causes. Retention of urine, also, is an attendant or consequence of hysteria, of paralysis, or other affections of the bladder, such as a preternatural thickening of its coats, &c.; in short, there is hardly any affection liable to be produced by such a variety of circumstances; or that requires more careful attention and study on the part of the surgeon; within whose province the treatment of this affection usually depends.

Retention of urine when complete and permitted to continue for some time, almost always ends fatally; either by acting on the kidneys and producing suppression of urine, and other formidable consequences; or by terminating in rupture, gangrene, &c., of the bladder. Even when permitted to exist in a slight degree for any length of time, it is very apt to terminate in partial paralysis of the bladder, or other distressing affections; not only of that organ, but of the kidneys and system in general.

As retention of urine depends on such a variety of causes, many of them belonging exclusively to the surgeon, of course the treatment must be various. Generally speaking, when inflammatory symptoms are present, the usual well-known means for removing such symptoms must be speedily had recourse to. If the retention depends on a cause of a spasmodic character, in conjunction with warm fomentations, &c., sedatives, and particularly a full dose of opium, either internally or by way of clyster, will be useful. In spasms of the neck of the bladder, in particular, the *tinct. ferri muriatis* may be repeatedly administered, till the desired effect is produced. The plan of treatment to be adopted in hysterical retention of urine has been already described.*

When the above means fail, and when the retention depends on a mechanical cause that cannot be removed, and the catheter cannot be introduced so as to draw off the urine, recourse must be had, for immediate relief, to puncturing the bladder.

Incontinence of Urine, like suppression and retention, depends on a variety of causes. In early life, it is often associated with some tendency to urinary disease, and very frequently with a disposition to gravel; or sometimes, as in young females, with constitutional weakness and irritability. In advanced life, as already stated in the preceding pages, incontinence of urine is usually associated with disease of the neck of the bladder or prostate, either of an organic or paralytic character. Incontinence of urine in children takes place, for the most part, in the night only, and while they are sleeping; and in some of these cases, if close inquiry be made, it will be found, that the urine is passed off voluntarily, under the influence of a dream. In such cases, on examining the urine, I have generally noticed some

* See page 395.

unnatural property of that secretion ; and most commonly a strong disposition to, or actual deposite of, gravel. Hence I have been led to infer that in this species of urinary incontinence, the acrid properties of the urine are chiefly in fault ; and that these unnatural properties, favoured perhaps by the position of the body, and probably also by the morbid sensibility of the bladder, excite so vivid an impression on the imagination during sleep, as actually to lead to a voluntary discharge of the urine. This form of incontinence of urine sometimes commences during the period of dentition, and is afterwards kept up by mere habit, and particularly by the custom of lying on the back, which has considerable effect in exciting the affection ; and in some individuals in whom the original cause has been long removed, the incontinence seems to occasionally recur from this circumstance.

On the other hand, we meet with cases of incontinence of urine in young people, which may be considered as of an *involuntary* or passive nature ; and in which the urine not only flows off in the night, without the consciousness of the patient ; but even by day the patient can scarcely control the discharge, and is obliged to empty the bladder more frequently than natural. In some of these cases, the urine, as before, is unnatural, though in a very different way ; that is to say, the secretion is copious, pale coloured, of low specific gravity, and even serous—in short, there is actual diuresis. In others of these instances, neither the quantity nor quality of the urine appears to be in fault ; but there seems to be some peculiar morbid condition of the urinary organs. Both these forms of urinary incontinence in young people are exceedingly difficult to be overcome, and sometimes remain till long after puberty, and even till late in life, in spite of every remedy. These forms of the affection, as well indeed as the form first mentioned, sometimes run in families ; and I have known almost all the children, and particularly the females, of a large family, more or less subject to incontinence of urine.

Incontinence of urine in aged individuals is generally of a very different character from the preceding form of the affection ; and may depend on a variety of causes, enumerated in the preceding chapters ; such as chronic enlargement of the prostate, &c. ; general paralysis ; partial paralysis, produced by injuries of the

spine, or over-distension of the bladder; or by some injury of the neck of the bladder or urethra, caused by the passage of calculus, &c.

The *treatment* of incontinence of urine of course must vary according to its cause and nature. In those children, in whom incontinence is associated with gravel, it is of the utmost importance that this point should be attended to, and the appropriate treatment employed in the first place; for unless the tendency to gravel be corrected, it is in vain to expect relief from other remedies. For this purpose, great attention should be paid to diet; that is, soups and sweets, in the form of pastry and other indigestible articles, should be prohibited; and the softest water only should be employed on all occasions. In addition to these means, some contrivance should be adopted to prevent the little patient from lying on his back; and if the affection appears to depend on habit, this habit should be broken, if possible, by rousing the patient, and making him empty the bladder, before the usual period arrives at which he has been accustomed to wet the bed. When the tendency to gravel has been removed, and the habit of incontinence broken, the cure may be sometimes completed and rendered permanent, by the employment of gentle tonics; and particularly by the use of sea-bathing, &c.

The treatment of the more inveterate forms of urinary incontinence, accompanied by diuresis, and occurring in susceptible strumous individuals, is very difficult, and often resists all the means we can employ. Something may be gained by prohibiting altogether the use of fluids in the latter part of the day, and by insisting on great attention to diet, &c.; and, indeed, without attention to these points, the other means within our power are of little avail. In addition to these means, a blister may be applied over the sacrum; while the different preparations of iron, and particularly the muriated tincture of iron, may be given internally, either alone, or combined with vegetable astringents or tonics; or, in some instances, with other stimuli, as with the tincture of cantharides, &c. In many cases, however, the combination of gentle sedatives with the tonics are preferable. The application of cold with a view to its bracing effects, either in the form of a local or general bath, may be also useful in a few cases; while in others,

and perhaps in the majority of instances, in which the skin is unusually dry and torpid, the tepid sea-bath and cutaneous friction will be preferable.

In those forms of incontinence of urine, depending on spinal affections, we may resort to some of the above expedients ; but the real amount of benefit we can ensure to the unfortunate patient, is in general very limited. The remedies that offer the best chance of success are those of the counter-stimulant class, such as repeated blistering, setons, issues, even the actual cautery, according to some writers. With these may be conjoined the application of electricity, galvanism, &c. When the incontinence depends on paralysis or insensibility, or even on morbid irritability of the neck of the bladder and urethra, particularly in females, much benefit is sometimes derived from local applications, calculated to excite the natural sensibility of the part on the one hand, or to destroy its morbid susceptibility on the other; such are the nitrate of silver, and other well-known applications.

Incontinence of urine in the aged, depending on diseases of the neck of the bladder, enlarged prostate, and their consequences, retention of urine, &c., is, for the most part, incurable. Something may be done towards mitigating the sufferings of the patient, in a few instances, by limiting, as much as possible, the quantity of fluids taken ; and by frequently emptying the bladder by the catheter ; particularly before retiring to rest. In addition to which expedients, such of the means, internal or external, above mentioned, as appear suited to the particular case of the individual, may at the same time be resorted to.

Lastly, when the incontinence resists all the means we can employ, it becomes necessary to provide against the inconvenience, by the adoption of some mechanical expedient, either for preventing the flow of urine, or for receiving it as it flows. For these purposes, a variety of means have been proposed ; but none of them answer so completely as could be desired. The *jugum penis* has been much recommended by foreign writers ; but its use is open to very strong objections. The best expedient founded on the principle of pressure is an instrument so constructed as to act by means of a spring on the urethra in the perineum. Receptacles for receiving the urine as it flows away, may be procured at the instrument makers ; and some of

them occasionally answer tolerably well for males.* In females the difficulties are much greater; and perhaps a succession of clean sponges, enclosed in an appropriate oilskin case, is as good an expedient as any that can be adopted. To prevent the bed from becoming wet also, the patient should sleep on a piece of waterproof cloth or leather, covered with calico or thin flannel.

* The great objection to all receptacles for the urine is the very offensive smell they soon acquire by use. Hence some prefer a common bladder, or one of the skins used for sausages, which, as being things of little value, may not only be renewed daily, but sometimes answer much better than more costly expedients. The bladder or skin may be enclosed in a calico bag, furnished with strings, &c., for fixing it; and to prevent the regurgitation of the urine, the neck of the bladder or skin may be inverted inwards for two or three inches, so as to form a sort of valve. Some fill the bladder, &c., with comminuted sponge; which after being well washed and dried, may be repeatedly used for the same purpose.

CHAPTER VII.

OBSERVATIONS ON THE REMOVAL OF CALCULI FROM THE BLADDER; COMPRISING REMARKS ON THE EFFECTS OF SOLVENTS FOR THE STONE, AND ON THE OPERATIONS OF LITHOTOMY AND LITHOTRITY; WITH A REVIEW OF THE CIRCUMSTANCES WHICH OUGHT TO DETERMINE THE CHOICE OF ONE OF THESE MEANS IN PREFERENCE TO THE OTHERS; OR WHICH RENDER ALL OF THEM DANGEROUS.

THE cure of calculous diseases, is a problem that has occupied the attention of medical men from the infancy of the art. The removal of the calculus from the bladder by a surgical operation was early, and still continues to be practised; and this formidable alternative of cutting, not only first led to the attempts to get rid of the concretion by some more gentle and safe expedient; but still urges on both doctor and patient to the attainment of the same desirable object. I am sorry, however, to be obliged to confess at the outset, that in spite of all the boasted light of modern science, the problem remains unsolved; and that we cannot by any known medicinal means, (or at least by any known method of directing these means,) get rid of a large calculus in the bladder, by other than by mechanical expedients. When I make this avowal, I must request not to be misunderstood. I do not mean to assert, that the removal of calculi from the bladder without surgical operation is impossible; neither do I mean to assert that nothing has been done towards accomplishing so desirable an object. On the contrary, I not only believe, or rather hope, that the object will be attained; but willingly admit, that considerable progress has been already made in certain favour-

able instances, towards the attainment of such object. Within the last few years, however, and subsequently to the publication of the second edition of this volume, the operation of Lithotripsy, or of crushing the stone in the bladder, has been introduced; and this important improvement has so changed the relations between the medical and surgical methods, that they almost cease to be contrasted, and consequently have lost a good deal of their interest. We shall take a short review of the above subjects under the following heads: First, with reference to the removal of concretions from the bladder, by natural or medicinal expedients: Secondly, with reference to the removal of concretions from the bladder by surgical expedients; and to the circumstances which should determine our choice between lithotomy and lithotripsy: and Thirdly, with reference to the question—what are the conditions of the kidney, &c., which in the present state of our knowledge and experience, should deter us from attempting the removal of the stone by any expedients.

1. Of natural and medicinal expedients for removing concretions from the bladder.—We have seen that healthy urine is so constituted, as never to be in a state of complete saturation even when cold. At the temperature of the human body, therefore, its point of saturation may be supposed to be still further raised; and we may consequently infer, that a perfectly healthy condition of the urine is not only one of the most natural, but probably, also, one of the most powerful solvents for all the ingredients likely to exist in urinary calculi, that we can hope to possess. So satisfied am I of the general truth of this remark, that my belief is, that there is scarcely any form of stone, that would long bear the continued action of healthy urine, without becoming more or less dissolved or disintegrated. This view is founded on the spontaneous changes which calculi sometimes undergo in the bladder itself; and on the length of time calculi occasionally remain in that organ, during which they not only do not become larger, but in some instances, there is reason to believe, actually become less. A few striking examples are sufficient to illustrate my meaning; but were I to detail all the minor examples of similar occurrence that have fallen under my notice, they would occupy a large space.

Some years ago I was requested to see an old gentleman

labouring under all the symptoms of a lithic acid calculus in the bladder, from which he suffered considerable inconvenience; but not so much as to materially injure his health, or to affect the properties of the urine. He was very obstinate, and would neither be sounded, nor persevere in the medicines recommended to him. He went on for a year or two, suffering occasional pain and irritation, but without having recourse to medicines of any kind; at least medicines directed to the bladder affection. At this time, he began to pass away from the bladder, with more or less of irritation, fragments of lithic acid, which had evidently formed portions of different calculi; some of them of considerable size. He continued to pass these fragments occasionally for a year or two; at the end of which time he had passed as many as filled a small box; which had all the appearance of fragments voided by individuals who have undergone the operation of lithotomy. He was at this time upwards of ninety years of age, and still passed large fragments of calculi, which sometimes gave him great pain. After an unusually severe attack, I was called to see him. I found him a good deal shaken, but he soon recovered, and began to void fragments of lithic acid as before.* The question here was, what caused the disintegration of these calculi? I confess I am unable to answer this question, except on the principle above mentioned. The effect could not be ascribed to medicine, for none had been taken when the fragments first began to come away; neither could it have depended on mechanical means, for no instrument had there been introduced into the bladder. We can only refer the phenomenon, therefore, to the properties of the urine; which, even nearly to the last, differed little from the normal condition. There was occasionally a little blood and some mucus in the urine, but never enough to render the secretion permanently alkaline, or to indicate disease of the bladder; in which case it is probable he would not have lived so long in good health. It is remarkable, that the edges of some of the fragments at first voided, were sharp and angular, as if the fracture had been recent; while the edges of those more recently passed were blunt and rounded, as if they had been some time in the bladder, and subjected to a sol-

* This gentleman has lately died, and calculi of considerable size were found in his bladder.

vent process.* I have seen many cases analogous, or similar to the above, but in some of them, alkaline medicines had been given, which obtained the credit of the cure. In another case of a patient far advanced in life, who, as he had not been suspected of having stone, had not taken alkalis, I once saw a great many fragments of a large calculus passed from the bladder. These fragments, moreover, did not consist of lithic acid ; but of an unusual compound, of which the oxalate of lime formed a principal ingredient. This gentleman did not afterwards, apparently, suffer more from bladder irritation, than many individuals of his age who have no stone in that organ ; and he at length died from another disease. He was never sounded, and I am unable to state whether a concretion remained in the bladder or not.

I have already mentioned that calculi often remain in the kidney and bladder for very long periods, without apparently increasing in size or giving much uneasiness. I have many times had opportunities of watching such cases, and have observed the urine, either from temporary derangements of the health, or from other causes, become alkaline, and deposit the phosphates for a few days. By a little rest and attention, however, all this has disappeared, and the urine has resumed its former acid condition. On such occasions, we can scarcely doubt that a slight deposition of the phosphates sometimes takes place on the calculus in the bladder ; and that when the urine again becomes acid, such phosphatic deposite is redissolved. Of course these inferences cannot be grounded on ocular proof; yet by close attention we may occasionally obtain such evidence, as to leave little doubt of their correctness. Thus, long after the urine has recovered its acidity and ceased to deposit the phosphates, there may not unfrequently be seen in such cases, large grains, (and sometimes scales, or thin laminae) of the mixed phosphates, which present every appearance of having been detached from a lithic

* On dividing lithic acid calculi, I have many times found their interior separated into innumerable fragments, by slits radiating from their centre towards their circumference. In this state they very readily break to pieces. Such calculi appeared to have been rapidly deposited, and to have contracted during their solidification, like clay nodules, or starch. In this way the occasional spontaneous fracture of lithic acid calculi may be probably explained.

acid nucleus. Those thin layers of the phosphates, also, which we often see interposed between the different laminæ of lithic acid in large concretions, show that during the formation of the calculus, such temporary changes as those above mentioned have at different periods taken place; while the partial abstraction and peculiar appearance of these laminæ unequivocally prove that they have, in some instances, undergone material changes since their original deposition.*

For the following remarkable instance of the effects of a perfect state of health, and of a natural condition of the urine, both in preventing the enlargement of a calculus, as well as of obviating its painful effects, I am indebted to the late Mr. Richard Smith, of Bristol:

"In 1804, I sounded a man in the (Bristol) Infirmary, and would have cut him then; but he was frightened and left the house. He became a common sailor—fought in several actions on board a man-of-war, and was discharged at the peace, *never having been inconvenienced in the slightest manner*. In 1831 he came to us again, told me who he was, and his history; and as the calculus was *now* troublesome, was cut and did well."† During the above long period of twenty-seven years, we can hardly suppose that the stone remained stationary; and as it was constantly placed in a fluid capable of acting as a solvent, and could, therefore, scarcely have increased in size, the supposition is not unreasonable, that on the whole it actually became less. Yet as the entire stone was not removed, when the general health became deranged and the urine unnatural, the portion left was

* Many of the thin white films between the laminæ of lithic acid calculi do not depend on the phosphates; but consist, in some instances, of a little lithate of soda, or, in others, of bleached and water-worn lithic acid.

† Extract from a letter, dated March 31st, 1838. Mr. Copland Hutchinson would probably have considered this case corroborative of the fact he attempted to establish,—that a seafaring life is an antidote to calculous affections. Without admitting or denying this fact, we can understand how, during a long state of activity and health, the urine remained in a natural condition, and therefore unfavourable to the calculous accretion; and how during a state of inactivity, and probably, therefore, of deranged health, the urine again became deranged, and the calculus, in consequence, troublesome.

sufficient to operate as a nucleus, around which depositories subsequently took place.

As stated at the commencement, I could readily multiply proofs and arguments in favour of the opinion I have advanced, viz. that the urine itself, when in a perfectly natural condition, is one of the most universal as well as powerful solvents we possess, for its own diseased depositories. This, however, I do not think necessary; for even those who doubt or deny this opinion, will scarcely call in question the practical inference to which it leads, viz. that in all cases of urinary concretion, one of the first points to be attended to, is to restore the healthy condition of the urine, by improving, as far as we are able, the general health, and the local condition of the urinary organs.

Medicinal solvents for the stone have been employed in two ways, viz. by the mouth, and by injection into the bladder; but before we take a short review of the employment of solvents in these two modes, it may not be amiss to make a few remarks on the subject of solvents in general.

The two great classes of solvents for the stone may be divided into the alkaline and the acid. Now the composition of the urine and of urinary calculi is such, that some of the ingredients of which they consist are soluble in alkalies, and some in acids. Moreover, except in positive diseases of the kidney, the urine is never devoid of both these classes of principles. When, therefore, we introduce an alkali or an acid into the bladder in excess, with the view of acting as a solvent, we not only infringe the important maxim above inculcated, and render the urine *unnatural*; but as a necessary consequence, we run the risk, while we dissolve one ingredient, of precipitating another. Hence, alkalies and acids, even if we could introduce them into the bladder in their free state, would be at least doubtful remedies; and in the majority of cases perhaps would be positively mischievous.* Fortunately, however, alkalies and acids cannot be introduced into the bladder through the system, without undergoing material changes; for the vital powers, when they retain anything like their natural

* The use of caustic alkalies not only impairs the digestive functions much more than the use of the carbonated alkalies, but while they are less efficient as solvents, they have much more tendency to precipitate the phosphates;

energies, exert themselves either to neutralize or to destroy their effects.

When, therefore, we consider that in healthy urine there is no free and uncombined alkaline, or acid ingredient; when also experience teaches us that vital agency, without extreme violation of its laws, will not permit the introduction of any free or positive agent into the bladder; how can we arrive at any other conclusion, than that uncombined agents of the alkaline or acid kind are ill calculated to act as solvents for calculi; and that solvents are to be sought for among a class of neutral and unirritating compounds, the elements of which are so associated as to act at the same time with respect to calculous ingredients, both as alkalies and acids? At present, no such neutral compounds of a decided character are known, or appear likely to be discovered; yet, as no chemical fact can be stated *a priori*, we know not what remains in store among the arcana of nature.

The nearest approach to a solvent possessing the properties above mentioned that we are perhaps acquainted with, are those forms of the alkaline carbonates, in which the carbonic acid is in great excess—in short, such compounds as exist in a great many natural mineral waters, and particularly those of Vichy. In some of these waters, the other saline compounds may contribute to the effect in a way at present unknown; but in the greater number, their solvent and disintegrating powers seem to depend, partly on the supercarbonated alkalies they contain; and partly on the quantity of fluid in which such supercarbonated alkalies are taken. Moreover, the improvements in the general health arising from the change of air, diet, &c., aided by the steady perseverance for a long time in their use, all conspire to favour the effects of the waters, and to secure their utmost influence. That waters of the above description, when thus perseveringly employed, are capable of acting both on lithic acid as well as on phosphatic calculi, is generally admitted; nor perhaps is their *modus operandi* very unintelligible; for such waters, from the

and in some habits, if not in all, they certainly give occasion to the formation of oxalic acid. For these and for the other reasons mentioned in the text, I have long abstained, (except under peculiar circumstances,) from the use of the caustic alkalies in calculous affections.

quantity in which they are usually taken, and from the hurried operation of the kidneys, actually make their way to the bladder but little changed ; where the alkalies they contain may be supposed to exert their feeble powers by dissolving the lithic acid ; and the carbonic acid, by dissolving, or at least by retaining in solution, the phosphates ;—two objects, which, when aided by plenty of water, are by no means incompatible within certain limits. Nor is the operation of such highly carbonated waters confined to their mere solvent effects ; they undoubtedly possess *disintegrating* powers ; that is, powers of disturbing the attraction, both cohesive and adhesive, by which the molecules of calculi are held together, so as to render them brittle and easily broken into fragments.*

It need not be stated, that our soda and potash waters are artificial compounds originally intended to represent these mineral waters ; and that when duly prepared and adjusted to particular cases, they are often, *medicinally* speaking, equally efficient ; and if in reality they fail to be beneficial in the same degree, the difference probably arises more from the absence of the circumstances above alluded to, namely, the change of the air, of scene, &c., which always accompany the use of mineral waters at their source, and doubtless add very much to their powers ; than from any want of action in the remedies themselves.

Artificial soda and potash waters should, as just stated, to ensure their utmost benefit, be varied and adapted to particular cases. As solvents, the potash waters are preferable ; and when the calculus is of the lithic acid variety, and the diathesis decided, from 3ss. to 3j. of the carbonated alkali, and as much of the tartrized soda, or phosphate of soda may be dissolved in each bottle, and be taken twice a day with an equal quantity of warm distilled water. On the other hand, when the concretions consist of the phosphates, and the urine is decidedly alkaline, the alkali may be omitted altogether, and the compound may either consist of distilled water impregnated with carbonic acid ; or occasionally some acid, as the phosphoric or nitric, may be substituted for the alkali. By adjusting the remedy to the particular circumstances of the case between these two extremes ; by large dilution ; by attention to diet and exer-

* See the recent works of M. Pettit on these subjects ; and particularly on the Vichy waters. Paris, 1834 and 1837.

cise, and by *perseverance*; it is probable that an impression may be made on the calculi in the kidney and bladder in some instances; at least as much impression as is made by any known mineral water. The worst of this class of remedies however is, that though in many instances they act *tutò et jucundé*, they can not be said to possess the third great requisite of acting *citò*. Nor are they only long and tedious, but they are *uncertain* in their operation; and though the concretion may be dissolved or disintegrated, and large quantities be brought away, yet an accidental fragment may be left, sufficient to form a nucleus for renewed accretion; and thus to embitter the future existence of the patient. Moreover, from the length of time required for the use of such solvents, they are only calculated for the idle and wealthy; and those who are actively engaged in the business of life, can neither bestow the requisite time nor attention to their application. There are many individuals, also, who cannot persist in remedies of this class without great detriment to their assimilating powers and nervous system, however carefully they may be adjusted to the case and circumstances; and such individuals, when unfortunately afflicted with calculous affections, are obliged to resort to other expedients. For these and other reasons that might be adduced, I fear that the hopes of relief which can be fairly and honestly held out to patients afflicted with stone, from all solvents at present known, are not such, except in a very few instances, as ought to induce them to delay having recourse to more efficient remedies.

The above observations apply more especially to lithic acid and phosphatic calculi. The oxalate of lime calculi, not only from their state of aggregation, but from their chemical properties, are still more refractory; nor are there at present, I believe, any means known, which can be reasonably expected to act as solvents or disintegrants of this variety of calculus.

The application of solvents for the stone by injecting them into the bladder, is another mode recommended for the employment of this class of remedies; and there are some forms of the affection in which this mode of applying them may be beneficial. On the whole, however, this mode of applying solvents is open to still greater objections than the taking them internally. They cannot be employed in an active form; and the length of time in conse-

quence during which it becomes necessary to keep the bladder, &c., in a state of excitement by the introduction of the necessary instruments, constitutes an almost insurmountable objection to their general use. The only form of disease to which they seem in any way adapted are certain conditions of the mucous membrane of the bladder, accompanied by a deposition of the phosphates. In such cases, I have seen the injection of a weak acid decidedly beneficial, not only to the mucous membrane of the bladder, but in disintegrating phosphatic concretions.*

2. We have now to make a few observations on the *mechanical* methods of removing calculi from the bladder, viz. *lithotomy* and *lithotripsy*—operations with which, viewed as mere matters of surgery, we have nothing to do. Our remarks will be confined solely to the effects and consequences of lithotomy and lithotripsy considered as therapeutic means. The subject may be viewed under the two following heads, viz. the comparative *safety*, and the comparative *practicability*, of lithotomy and lithotripsy.

If we view the *safety* of an operation as bearing a certain relation to its severity, which generally speaking, perhaps, we are justified in doing, there can be little hesitation in deciding generally, that the safety lies on the side of lithotripsy. In lithotripsy there is not, or ought not to be, any breach even of surface; while lithotomy not only necessarily requires an extensive breach of surface, but of substance; and, in short, however dexterously performed, may be considered, from the very nature of the organs concerned, as one of the most formidable operations of surgery. Such is the general result of the comparison, everything being considered as equal and favourable; but such a consideration is rather hypothetical than real; and we have to view matters as they are, rather than as they ought to be.

The best test of the safety of an operation is derived from statistical details. On the side of lithotomy this point has been extensively investigated, and the general result is, that of the whole

* See Sir B. Brodie's Lectures on Diseases of the Urinary Organs, p. 295, et seq., third edition. Dr. Hoskins, of Guernsey, has recently proposed a solution of the saccharate or acetate of lead as a solvent for the earthy phosphates; to be injected into the bladder.

number of individuals lithotomised, one in seven or eight dies. On the side of lithotrity, from its recent origin, and its progressive, and perhaps still imperfect character, we have no data fairly comparable with the above; nor indeed any very satisfactory data, for the additional reason,—that lithotomy, when it proves fatal, destroys life in a few days at the utmost; whereas lithotrity, though it may become a cause of death, seldom kills at once; for a patient may linger for weeks or months, and *apparently* die from other disease, though the remote cause of death might have been lithotrity; of which I have seen many instances. I am doubtful, therefore, if everything be taken into account, whether the mortality on the whole has not been nearly as great from lithotrity, as from lithotomy.

Let us now view the matter with reference to the pain and suffering arising from the two operations. Lithotomy, even at the best, is a most painful and severe operation; lithotrity, when dexterously performed under favourable circumstances, on the contrary, is attended with very little pain. Here, as before, the advantage, generally and abstractedly speaking, is all on the side of lithotrity; but how do matters stand in reality? The pain in lithotomy is concentrated into a few minutes, and afterwards, comparatively speaking, the suffering is usually trifling. The pain of lithotrity, on the contrary, (which may be, and often is, very severe,) is frequently distributed by repetition over weeks and even months; so that the amount of suffering from lithotrity may be even greater than from lithotomy. Again, by the operation of lithotomy, the stone is at once entirely removed, and there is no chance of a nucleus being left for future accretion; on the other hand, there is no absolute certainty in lithotrity that all the stone is removed; and fragments may be left, which may serve as nuclei for future formations. Moreover, independently of accidents of this kind, the operation of lithotrity seems to often leave a greater tendency in the system to form future deposits than the operation of lithotomy. The shock produced on the constitution by the formidable process of cutting; and the salutary effects induced on the health by the renovating processes necessarily following the operation, aided perhaps by the severe discipline he otherwise undergoes, sometimes seem to produce such a total change in the habit of the patient, that a tendency to form gravel,

&c., does not recur for a long time after the operation. On the contrary, from the little suffering produced by lithotritic operations in some instances, and the severe derangements of the mucous membrane of the bladder sometimes following in others, the disposition to form lithic acid gravel on the one hand, remains much the same after, as before the operation ; while the disposition to form phosphatic calculi is too often increased. For these and many other reasons which might be mentioned, we are obliged to confess, that the balance which, at first sight, seems to be so much in favour of lithotritry as compared with lithotomy, is in reality, as it has been generally practised, very much diminished. We may hope, however, that the ingenuity, skill, and perseverance, of the inventors and cultivators of the art, by which so much has been already accomplished, will lead to still further improvements.

We have, in the next place, to consider the *practicability* of lithotritry, as compared with lithotomy. The practicability of the operation of lithotritry as compared with that of lithotomy, other things being equal, depends on the size of the stone; on the capacity of the urethra (and therefore the age) of the patient; on the composition, in some respects, of the stone; and on the idiosyncrasy of the patient. The magnitude of the stone increases the difficulty of extracting it both by lithotomy and lithotritry; but the ratio of the difficulty, and consequently the practicability of removing the stone by lithotritry, increases so rapidly with the size of the stone, that the operation becomes impracticable long before the operation of lithotomy. When the stone, therefore, is of a large size, and the operation of lithotomy in consequence becomes proportionably more difficult and dangerous, lithotritry in its present state fails us altogether, and the patient has no alternative but to be cut in the old way. This is undoubtedly much to be lamented; for though very large stones are by no means of common occurrence, and will probably hereafter be still more rare, yet they sometimes occur, and it becomes a painful task to inform the patient or his friends, that there is no other means of relief than that of a severe operation, rendered unusually difficult and dangerous by the circumstances of his case. Lithotritry, therefore, is only fairly comparable with lithotomy, when the stone is of a moderate or of small size; and in such cases, un-

doubtedly the balance is very much in favour of lithotripsy. A small or moderately sized calculus can now, in the great majority of instances, be crushed and removed, without much pain or risk to the patient ; and without much chance of fragments being left in the bladder. Or should fragments be left, and future calculi be formed, *they in their turn can be removed with equal facility. In short, from the present time, very few if any need suffer from a *large* stone in the bladder, provided they apply for advice as soon as *the symptoms are perceived ; to which early application, the facility, safety, and certainty, from the operation of lithotripsy, as compared with the same operation when the stone is larger, or with the operation of lithotomy, hold out every inducement.

Other circumstances, particularly affecting the operation of lithotripsy, are mechanical impediments about the neck of the bladder or urethra, as enlarged prostate, stricture, &c., which render the introduction of the necessary instruments impracticable. Similar remarks apply to early age, when the narrowness of the urethra, and the natural irritability of the constitution at this time of life, offer great impediments to lithotripsy. In some of these cases, on the other hand, lithotomy is practicable with less hazard than ordinary ; as, for instance, in young children, in whom, as it appears from statistical investigations, the risk is, *cæteris paribus*, decidedly, less than in adults. Even simple enlargement of the prostate, according to Sir B. Brodie, is not to be regarded as adding to the danger of the operation of lithotomy, though it may add to its difficulty. Hence, as he observes, old men between seventy and eighty, sometimes stand a better chance than those who are ten or twenty years younger.*

Other things being equal, the quality of the stone may, comparatively speaking, have a certain influence as regards lithotomy and lithotripsy. Calculi of the oxalate of lime, and even sometimes of the lithic acid species, are occasionally so hard that they are crushed with great difficulty, and not without risk of bending or breaking the instruments ; and when such calculi are broken, the sharp and angular fragments are apt to cause great irritation in the bladder ; whereas, hardness of the stone, instead of being a

* Lectures on Diseases of the Urinary Organs, page 337. Third edition.

disadvantage, is rather an advantage in lithotomy ; the great object in lithotomy being, in all instances, to remove the stone at once and entire. For similar reasons a soft stone is favourable in lithotripsy, but unfavourable in lithotomy ; for in withdrawing the stone from the bladder, it is almost sure to be broken—an accident that not only complicates the operation, but may, by leaving a fragment in the bladder, give occasion to the formation of another calculus. On the other hand, there are circumstances connected with the hardness and softness of calculi which sometimes modify the above observations. Hard stones, like those of the mulberry and lithic acid varieties above mentioned, are usually connected with a sound and quiescent state of the bladder ; whereas soft stones, which usually consist of the phosphates, are often connected with an irritable or diseased condition of the mucous membrane of that organ.

A sound state of the bladder is favourable for both species of operation. An unsound and irritable state of the bladder, like an enlarged prostate, though it may sometimes render lithotripsy very difficult or impossible, does not always prevent lithotomy. Idiosyncrasy often materially influences the practicability or success of an operation. There are some individuals in whom the urethra and bladder are comparatively so insensible, and who feel so little inconvenience, not only from the immediate, but from the constitutional effects of instruments, that they can almost tolerate anything ; whereas, we meet with others, who suffer the greatest irritation, both local and constitutional, from the mere introduction of instruments, and in whom consequently, even the attempt at lithotripsy is almost impossible ; such individuals, therefore, if relieved at all, can be only relieved by lithotomy. These differences may in some degree depend on the degree of moral courage of the patient ; but I have seen instances in which they could not be referred to this cause.

3. Finally, we have to make a few observations on the circumstances which *forbid, altogether* the attempt at removing calculi from the bladder ; at least by mechanical expedients. Whenever the kidneys are decidedly diseased, all operations, but particularly operations about the urinary organs, are dangerous on account of the facility with which inflammatory action is apt to be induced on the diseased structure, and to prove fatal. The different forms

of diseased kidney, however, are, *cæteris paribus*, attended with different degrees of risk. Thus most of the affections of the kidney connected with anaemotrophy, and occurring in early age, so enfeeble the vital energies, and particularly the vital powers of renovation and resistance to disease—in short, so impair the tenure of life, that the slightest shock whether from epidemic disease, or from a surgical operation, is almost sure to destroy life. Whenever, therefore, disease of the kidney of this kind is distinctly ascertained to be present, all operations and particularly the operations of lithotomy and lithotripsy, are quite out of the question; as they will very probably only abridge the existence of the patient, without giving him a chance of recovery. On the other hand, affections of the kidney of the haemotrophic kind, though with due preparation, they may bear surgical operations much better; are not always free from risk. Indeed without preparation, the risk is fully as great as in affections of the anaemotropic character; for the inflammatory action liable to be super-induced in the kidney is sometimes so acute, and so rapidly assumes the adynamic form, that it becomes perfectly unmanageable. In all cases of serous urine, therefore, in middle-aged plethoric individuals, particularly if the urine be of high specific gravity and deposits the lithate of ammonia, before any operation be attempted, the system should be prepared by cupping and active aperients; by which expedients, the danger from the operation, in a great many instances, is very much diminished.

Nearly the same observations apply to organic diseases of the bladder, the existence of which are unfavourable for the operation of lithotripsy, as well as of lithotomy. Indeed, chronic inflammation of the mucous membrane of the bladder, as before observed, is more unfavourable for lithotripsy than for lithotomy; for sometimes when the stone is removed by lithotomy, the state of the bladder becomes improved to an extent that would scarcely be expected; whereas the inflammatory excitement is sure to be increased by lithotripsy, and its consequences.

In the preceding observations, I have endeavoured to take a brief but impartial review of the operations of lithotripsy and of lithotomy, and of the cases to which they are respectively applicable or inapplicable; and it only remains, in conclusion, to reiterate the important truth, that the operation of lithotripsy has

now so much diminished the risk, the pain, and other bad effects of the presence of a *small* stone in the bladder in a healthy individual, that very few cases occur in which we are justified, under such circumstances, in recommending or allowing the stone to remain in that organ; and consequently that every one with symptoms of calculus ought to apply as early as possible for advice, and, if deemed practicable, to submit at once to the operation, and get it removed.

B O O K III.

COMPRISING AN OUTLINE OF THE GENERAL PHYSIOLOGY AND PATHOLOGY OF ASSIMILATION; AND OF THE SECRETION OF THE BILE AND OF THE URINE.

THE following pages contain a brief sketch of the General Physiological and Pathological views on which the preceding Practical Treatise is founded. In the earlier editions, this sketch constituted the INTRODUCTION; but on account of its length, as well as for other reasons alluded to in the preface, I was induced in the last edition to invert the arrangement, and to consider the subject under the denomination of a THIRD Book or PART, comprising the following HEADS or SECTIONS:

SECTION a. Of the ultimate composition and structure of organized bodies; and of their general physical characters, as dependent on their composition.

SECTION b. Of alimentary proximate principles.

SECTION c. Of the primary processes of assimilation.

SECTION d. Of the secondary processes of assimilation.

SECTION e. Of the general pathology of the primary and secondary assimilating processes.

SECTION f. Of the general composition and properties of the blood.

SECTION g. Of the functions of the liver, and of the composition and relations of the bile to the assimilating processes.

Of biliary concretions or gall-stones.

SECTION A. Of the functions of the kidneys; and of the composition and relations of the urine to the assimilating processes.

Of urinary calculi.

APPENDIX.

Containing Tables illustrating the number of fatal cases of Diabetes and Calculus in different districts of England and Wales; the comparative prevalence and laws of formation, and alternation of different calculous depositories; of the comparative prevalence of calculous affections at different ages and in the different sexes; and of the rate of mortality from the operation of Lithotomy.

SECTION a.

*Of the ultimate composition and structure of organised bodies ;
and of their general physical characters as dependent on their
composition.*

THE objects of nature are divided into the inorganised and the organised. Under the head of inorganised bodies are included all elementary principles and their *mineral* compounds. Under organised substances are included all substances forming a living constituent of vegetables and animals. With the general nature of common chemical or *mineral* elements and their compounds, we take for granted the reader is acquainted. We confine our attention, therefore, solely to organised products.

Organised bodies include *vegetables* and *animals*; and in their well-marked forms, no two things can perhaps be conceived to offer a stronger contrast than these two great divisions of organised bodies. Yet vegetables and animals so gradually approximate, that their characters appear to coalesce; and at, and near, this point of coalescence, it often becomes difficult to discriminate between the two divisions of organised beings, and to pronounce with certainty which is vegetable, and which is animal. Nor does the *chemical* composition of vegetables and animals assist us in overcoming this difficulty. It is true, indeed, that vegetable substances in general contain essentially no more than three elements, *hydrogen*, *carbon*, and *oxygen*; while animal substances usually involve a fourth, *azote*; yet there are many vegetable matters of whose composition azote forms a considerable part; while certain animal substances are entirely wanting in that principle. The chemical composition of a substance, therefore, as already stated, will not enable us to determine whether it belongs to the division of vegetables or of animals; and when it happens to be doubtful or unknown, other data must be called into requisition, before the point can be determined.

Besides the four constituent elements mentioned, of which all organised substances are essentially compounds; other principles generally enter into their composition. These other principles, which are in very minute quantity, are not so essential to the existence of organised substances, as the four constituent elements above mentioned, yet, however minute the quantity, the influence of these other principles seems to be most important; they are *sulphur, phosphorus, chlorine, fluorine, iron, potassium, sodium, calcium, magnesium*, and probably more besides. These principles have by most chemists been deemed extraneous, or foreign to organised bodies; but we have elsewhere attempted to show that there is good reason to believe that the office of such additional principles, though different from that of the four constituent elements of organised bodies, are nevertheless most remarkable. These four elements, along with the additional principles, are, in the present state of our knowledge, alike denominated the *ultimate elements* of organised bodies; but *hydrogen, carbon, oxygen*, and *azote*, may be termed, for the sake of distinction, the *essential elements*; and *sulphur, phosphorus, &c.* the *incidental elements* of such bodies. Finally, the combinations with one another, according to certain laws, of the ultimate elements of which all organised bodies consist, produce what are denominated the *immediate, or proximate elements* of organised bodies. Of such proximate elements, *sugar, oil, albumen, &c.*, are sufficient examples.

As our inquiry is principally limited to the chemical composition of organised bodies, a minute inquiry into their *structure* would be foreign to our purpose. We may, however, state, that of the many opinions advanced by physiologists on the subject, the prevailing opinion seems to be, that the ultimate structure of organised bodies is vesicular or cellular; in other words, that organised bodies consist of vesicles or (*nucleated*) cells, each one of which is, in a certain sense, a complete and independent system or *organised molecule*; that these organised molecules coalesce lengthways, and thus form fibres; and lastly, that these fibres, by adhering to, or interlacing with, each other in various ways, form the different textures of organised bodies. Different authors have taken somewhat different views of these subjects;

but whether the above, or the more recent views, be a correct representation of the matter or not, we shall not stay to inquire; it is sufficient for our present purpose to know, that in the ultimate and more elementary condition in which organised molecules are recognised by us, their composition not only differs altogether from that of mineral bodies, but that they never assume a crystallised or mineral form. Hence the solid aggregates of organised molecules are never, like crystals, defined by straight lines and angles, but are always more or less rounded. Even the fluids found in organised bodies are, for the most part, very heterogeneous in their characters, and consequently uncrystallisable; for though the basis of all organised fluids be usually water, yet many of them contain such a variety of other substances as to completely modify the condition of the water, and prevent the exertion of its properties as a mineral body.

The next important step in our inquiry is the investigation of the *causes* of organic peculiarities. Why do organised bodies differ so widely in their composition, and structure, and properties, from inorganised bodies?

The answer to this question in all its bearings is beyond our capacity. That there exists, however, in all living organised bodies some power or agency, whose operation is altogether different from the operation of the common agencies of matter, and on which the peculiarities of organised bodies depend, is universally admitted. A variety of opinions have been entertained on the subject of these organic agencies by different philosophers, none of which require more than a brief notice here.

The chief opinions, or rather *hypotheses*, (for they are nothing more than hypotheses,) which have been framed to account for the phenomena of organisation, may be classed under three heads. viz. 1. The hypothesis of independent existing vital principles or "agents," superior to, and capable of controlling and directing, the forces operating in inorganic matters; on the presence and influence of which the phenomena of organisation and of life depend. 2. The hypothesis that vitality or vital agency is a property, not independent of, but superadded to, the common properties or agencies of matter; and 3. The hypothesis that the lowest kind of *vitality*, or *irritability*, as it is termed, is *the result*

of certain aggregations of inorganic matters ; and that this lowest kind of vitality or irritability is a “ property which, when acted on by appropriate powers, is competent to give rise to that series of actions in which life consists ;” in other words, as more explicitly stated by an advocate of this hypothesis, that “ as one specific property, namely, irritability or vitality, which is common to organised matter in general, qualifies it, when subjected to appropriate stimuli, to manifest those ruder and less elevated actions which constitute life ; so other specific properties peculiar perhaps to certain forms only of such matters, may qualify them, when properly acted upon, to display those more delicate and dignified actions in which sensation and thought respectively consist.”

Of these three hypotheses I have always chosen the first ; which is not only the most ancient, but has been generally adopted by physiologists in various modified forms, to the present time. The other two hypotheses are of more recent origin, and have been more or less exclusively adopted by certain modern physiologists. A detailed statement of my reasons for preferring the hypothesis of “ peculiar agents” in preference to the other hypotheses, which appear to me to be not only untenable but positively absurd, would be quite out of place here ; I shall, therefore, reserve what I have to say on this subject till a future opportunity.

Though differing so greatly and variously in their physical characters, we shall find, if we exclude incidental matters, such as the earthy base of bones, &c., that the stamina or groundwork of organised beings may be considered as constituted of four great classes of proximate principles. Moreover, as animal existence is supported by alimentary substances derived from the animal and vegetable kingdoms, these alimentary matters must of course be similarly constituted ; and aliments, in fact, may be viewed in the same light ; that is, the four great classes of proximate principles may be considered either as staminal principles, composing animal bodies ; or as aliments by which animals are supported. But as the latter view is in some respects most convenient for our purpose, we shall consider these proximate principles in an alimentary point of view.

* See Rudiments of Physiology, by John Fletcher, M.D. Part i. page 11.

SECTION.

Of Alimentary Proximate Principles.

FOR many years past, as just stated, I have been accustomed to consider alimentary principles as divided into four great classes or groups—a division now, I believe, generally aquiesced in by physiologists: at least in this country. These four great classes or groups may be denominated the *aqueous*, the *saccharine*, the *albuminous*, and the *oleaginous*; on each of which we shall proceed to make a few remarks.

Of the aqueous alimentary principle.—Water constitutes not only the medium in which most organic operations are performed; but its elements, either separately or as water, enter into the composition of every living organized being. The subject of water, therefore, in a physiological point of view, may be considered under two heads; as the medium in, or by means of which, all organic operations are performed; and as an alimentary principle.

The proportion of water entering into the composition of organized beings is so remarkable as to appear almost incredible. Not only does the blood contain four-fifths of its weight of water, but even the parts of the body termed *solids*, that is, the muscular mass of which animal bodies chiefly consist, contain in reality only about one fourth of solid matter. As an instance in illustration, we may mention a fact stated by Blumenbach, viz., that a perfectly dry mummy of an adult Guanche, in his museum, preserved with all the muscles and viscera entire, did not exceed seven pounds and a half in weight.*

The water thus constituting so large a proportion of living animal bodies is the medium by which all vital agencies are performed. In the blood, for instance, the solid organised particles are transported from one place to another; are arranged in the

* The original inhabitants of the island of Teneriffe are called Gauches. See the Introductory Observations to Blumenbach's *Physiology*.

place desired ; and are again finally removed and expelled from the body, chiefly by the agency of the water present. Water also imparts to the more solid constituents of the frame that peculiar flexibility and power of extension so characteristic of animal solids. In short, without water, matter in its solid state appears incapable of vitality (or at least of displaying vital properties) in the higher animals, or even in plants ; and in a few of the lower animals, vital processes are entirely arrested when water is withdrawn ; though in some instances they may be restored when this fluid is again supplied.

As water constitutes so large a proportion of organised beings, we may naturally suppose that, surrounded as they are by an atmosphere colder and drier than themselves, the quantity of water they contain is liable to perpetual change. Accordingly, we find this to be the case, and that aqueous vapour is either freely separated from the skin, from the lungs, and from other organs ; or perhaps, under different circumstances, is as freely absorbed by the same organs from the surrounding atmosphere. In these various modes, much of the water in animal bodies is doubtless liable to be changed ; but the great portion is separated by organs expressly adapted for the purpose, viz., the kidneys ; and supplied by fluids taken by the mouth in the form of drinks.

Of water considered as an alimentary principle, that is, as a constituent principle of organised products in the form of water, or when decomposed, as contributing the elements by which such organised products are elaborated, we can say but little here : for as water and its elements, as just stated, enter into every organic operation, to do justice to the subject, every organic operation should be detailed,—a circumstance, not only for this reason alone, even were the means within our power, impracticable ; but which is absolutely impracticable in reality, from the very little we know of the subject. A few of the instances in which water plays an important part as a *whole*, as well as of instances in which this fluid is decomposed, and its elements appropriated, have been incidentally noticed in former parts of this volume.

Of saccharine alimentary principles.—Under the denomination of *saccharine bodies*, we include a very large class of substances, the general composition of which appears to be similar ;

that is to say, they consist of a combination of carbon with water in various proportions. The analogy among these bodies is further proved by the facts that many of them are easily converted into others; and that they are all capable of forming the oxalic or some analogous acid, by the action of nitric acid.

The saccharine principles are chiefly derived from the vegetable kingdom, and indeed constitute what may be called, by way of distinction, *vegetable aliments*. As employed by man, some exist in the crystallised form, which, from the simplicity of their composition, they readily assume; though, as we have said, in the living plant of which they constitute a part, their form is anything but crystalline. Of crystallisable saccharine bodies, the chief are *sugar* and *vinegar*; of uncrystallisable or organised bodies, the most remarkable are the different forms of the *amylaceous*, or *starchy principle*; the different forms of *lignin*, or the *woody principle*; and the different forms of *gum*, or the *mucilaginous principle*.

Of sugar.—Sugar exists in considerable quantity, and but little complicated, in many plants. Moreover, the greater number of the other saccharine principles are capable of being converted into crystallised sugar, by artificial processes. Sugar is the only crystallisable product employed in considerable quantity as an aliment; and by the perfectly healthy stomach it seems to be readily assimilated. There are, however, certain states of disease in which this organ appears to lose, in a great measure, the power of assimilating this principle, and in such states of disease, sugar consequently is ill adapted as an aliment. Indeed, on the whole, though sugar, as we have said, is capable of being assimilated in large quantity, it is doubtful if mankind have been the gainers, except in convenience, by employing it in a form in which it is the furthest possible removed from organisation and life.

Vinegar or acetic acid, however dissimilar to sugar in its sensible properties, is nevertheless similarly constituted. Moreover, as is well known, most of the forms of the saccharine principle are readily convertible into vinegar, by different artificial processes. Vinegar, either by accident or design, has been employed by mankind, in all ages, in greater or less quantity, as an aliment; that is, substances naturally containing it in small quantity have been employed as aliments; or it has been formed

artificially from certain bodies with the view to alimentary purposes. Like sugar, this principle appears to be more difficult of assimilation in its pure and crystallisable form, than in that state of mixture or union in which, for the most part, it naturally occurs.

Lactic acid.—Nearly allied to vinegar or the acetic acid, is the peculiar acid which, from its having been first recognised in sour milk, is termed the lactic acid. This acid, like the acetic acid, is probably, under certain circumstances, capable of becoming an aliment; but as it is often found unchanged and even developed in the stomach, and indeed in almost all parts of the animal system, it is probably less digestible, and therefore less adapted as an aliment, than the acetic acid.

The remaining principles of the saccharine group, under no circumstances, natural or artificial, ever assume the crystallised form; and their structure, in the common and strict sense of the term, may be said to be *organised*. Of these the most important to mankind is,

The *amylaceous* or *starchy* principle.—The amylaceous or starchy principle is obtained in slightly modified states from a great variety of vegetables, but principally from the seeds of the *Cerealia*. Even by the unassisted eye, starch is seen to be composed of minute particles; and when these particles are examined with a microscope, they are found to be granules more or less rounded, and without the least trace of crystallisation. These granules are conceived to be insulated in the cellules of the texture in which they are formed; for it would appear, that their state, when first secreted and deposited in the cellules, is semi-fluid; and that the excess of water is subsequently removed. Raspail and Dumas have shown that each of these little grains is covered with a smooth integument, not affected by water at the common temperatures; within which integument is enclosed a substance rather more soluble. According to some chemists, this interior substance has an analogy with gum; but probably it is only a variety of amylaceous matter. Berzelius affirms that starch, when burnt, leaves about 23 per cent. of residuum, consisting entirely of the phosphates. But when this residuum is abstracted and allowed for, the essential composition of starch is

found to coincide very nearly with the essential composition of sugar; that is to say, starch is composed of carbon and water; and the proportions of their combination are very nearly the same as in sugar. The starch used as an aliment is principally derived, as we have said, from the seeds of the Cerealia or corn tribe; but varieties of this principle are found in the roots and other parts of many plants; arrow-root, from the roots of the maranta tribe; potato starch, from potatoes; sago, from the pith of the sago palm, &c.

The amylaceous principle is readily assimilated by the healthy stomach, and directly or indirectly forms a constituent of the food of most of the higher animals, as well as of man. It differs, therefore, from sugar, in being a *necessary* article of food, without which animals could not exist; while sugar is not. Hence a much larger quantity of amylaceous matter, than of sugar, can be taken; and what is a still more decisive fact, the use of this larger quantity of amylaceous matter may be persisted in for an unlimited period, which is not the case with a large proportion of sugar.

Lignin, or the *woody fibre*, though assuming a great variety of appearances in different plants, and including very different incidental matters, has nevertheless, in all the plants in which it has yet been examined, been found to possess very nearly the same composition; or to consist of about equal weights of carbon and water. Such at least is the composition of woods so very different as the box and willow, the oak and the beech. Hence it is perhaps not unreasonable to suppose that every variety of lignin has a similar composition. All woods, when burnt, leave a greater or less quantity of incidental mineral residuum, in the shape of ashes; the nature of which, as above observed, differs exceedingly in different sorts of woods. The composition of lignin will be given when we come to speak of the saccharine principle as it is found in the urine.

Lignin forms the appropriate food of numerous insects and of some of the lower animals, but of few of the higher classes of animals. The reason of this is probably to be sought for, in their not being furnished with organs proper for comminuting and reducing it; for when lignin is comminuted and

reduced by artificial processes, it is said to form a substance analogous to the amylaceous principle, and to be highly nutritious. *

The *gummy* or *mucilaginous* principles form a very numerous class of bodies, nearly allied, if not actually belonging, to the saccharine group, into which they appear to merge by imperceptible grades. As instances of these principles in their well-marked forms may be mentioned, the *sugar of milk*, among crystallised, and *gum arabic* among the uncryallised bodies. The mucilaginous principle chiefly differs from sugar by being converted by nitric acid into an acid called the *sac-lactic* or *mucic*, instead of the oxalic.

It seems to be generally admitted, that gums and mucilaginous matters are nutritious; and there can be little doubt that in certain proportions, and for a certain time, they are capable of constituting an aliment to man. In some forms of disease also, their peculiar composition and properties may even render them an appropriate aliment. But whether, like the amylaceous principle, they are adapted to constitute a human aliment for an unlimited time, may be questioned; though I know of no data at present, by which the point can be satisfactorily determined. †

Albuminous aliments constitute a very numerous class of bodies, all differing from each other in some slight particulars, but still having certain properties in common, so as to render it probable that their ultimate composition is similar, or at least analogous. Their composition cannot be stated here; but they all involve

* See this circumstance, which is stated on the authority of Autenrieth of Tubingen, alluded to in the Philos. Trans. 1827; also in my Bridgewater Treatise.

† The reader will observe that in the above as well as in other parts of this volume I have advanced an opinion regarding saccharine aliments totally at variance with the prevailing doctrine of the day, viz., that the only use of the saccharine class of aliments is to form animal heat by combustion in the lungs. I regard this hypothesis in its general and literal sense, as utterly at variance with the experience and common sense of mankind; and have no doubt that future physiologists will look back with wonder that any thing so absurd should, have been advanced, much less adopted, in the present "enlightened" age.

a fourth element, *azote*; and in this respect are strikingly distinguished from both the other classes of aliments.

Albuminous aliments are principally derived from the animal kingdom. Hence they are not inappropriately termed *animal aliments*. None of them exist naturally in the crystallised state; nor can they be made to crystallise by artificial means. Yet certain modifications of them readily assume the crystallised form; and in diseased conditions of the animal economy, in which such modifications occasionally exist in large quantity, they often concretes into masses, and prove a source of secondary disease, as already shown. The principal modifications of albumen are *gelatine*, *albumen* strictly so called, *fibrin*, *curd*, *gluten*, and perhaps a few others, which may be rather considered as varieties of some of the preceding matters, than as distinct substances.

Gelatine and *albumen*.—When any part of an animal body (with the exception, perhaps, of those composed entirely of oleaginous matters) is boiled in water, it is separated into two portions—one soluble in water, and forming with the water a tremulous jelly, or *gelatine*; the other remaining insoluble, indeed becoming harder the longer it is boiled; and, from the identity of its properties with those of white of eggs, denominated *albumen*. Gelatine and albumen exist in very different proportions in the different textures; some of these textures, as the skin, being almost entirely convertible into gelatine; while others yield comparatively little gelatine, and consist principally of albumen. In no animal compound does gelatine exist as a fluid; hence gelatine has been supposed to be produced by boiling; but the supposition does not appear to be well founded. Gelatine may be considered as the least perfect kind of albuminous matter existing in animal bodies; intermediate as it were between the saccharine principle of plants, and thoroughly developed albumen. Indeed, gelatine in animals may be said to be the counterpart of the saccharine principles of plants; it being distinguished from all other animal substance, by its ready convertibility into a sort of sugar, by a process similar to that by which starch may be so converted. Albumen exists in the fluid state as a component part of the blood; small quantities of fluid albumen are also contained in certain animal secretions; but there is much more of

the principle in a solid state ; and forming what is termed *coagulated albumen*.

Fibrin, another modification of the albuminous principle, is found in the blood ; and, like albumen, exists in the living body, in a fluid, or at least in a miscible state ; the most frequent condition of fibrin, however, is that of a tough fibrous mass, in which condition, together with albumen, it forms the basis of the muscular or fleshy parts of animals.

Curd is another modification of the albuminous principle, derived from the milk of animals, and principally designed to form the food of animals in the early stages of their existence ; before the digestive and assimilating faculties are completely developed.

Gluten, though chiefly derived from the vegetable kingdom, contains azote, and in its general composition closely resembles the albuminous principle. Like the fleshy parts of animals also, gluten may be separated into two portions, analogous to gelatine and albumen ; it has, therefore, been very properly considered as a modification of the albuminous principle. Gluten exists in different parts of vegetables, but principally in the seeds of the cerealia, and more especially of wheat. Hence the superiority of wheat to all other vegetable products as an aliment.

Of oleaginous aliments.—Oleaginous bodies occur in an infinite variety of forms, some being solid, others fluid ; yet, in every instance, their peculiar properties are so strongly marked that we seldom hesitate about their nature. In this distinctness of outward appearance, oily bodies are strongly contrasted with both the other alimentary groups, and particularly with the saccharine group ; many of which group have few *apparent* and sensible qualities in common. I have analysed many specimens of the more important varieties of this group of bodies, and have found them to be essentially composed of olefiant gas and water in different proportions ; or having reference to this composition. These analyses have not been published.

Oily bodies are naturally separated by their sensible and chemical properties into two great divisions ; viz. *fixed* and *volatile* oils. The fixed oils, solid and fluid, are found both in the animal and vegetable kingdoms. The volatile oils are chiefly found in

the vegetable kingdom, and in general are little used as aliments; unless we except *alcohol*, which, though conforming in its composition to the fixed oils, more nearly resembles in its properties the volatile oils. The fixed oils, as they naturally exist in vegetables and animals, are seldom so pure as to be capable of assuming the crystallised form. When they are separated, however, from the extraneous matters with which they are associated, many of them readily crystallise. The principal fixed oils employed by man, and derived from the animal kingdom, are *suet*, *lard*, *butter*, *train oil*, &c., while from the vegetable kingdom we have *olive oil*, *almond oil*, *nut oil*, and a variety of others. Almost all natural oily bodies, as obtained from animals and plants, are divisible into two portions, viz. a portion usually more or less solid, and called *stearine*; and another portion always remaining fluid, and termed *oleine*.*

Such are the four great alimentary principles, by which all the higher animals are nourished, and of which their bodies are essentially constituted; and if we regard carbon as the elementary principle by which, *cæteris paribus*, the nutritive powers of three of the alimentary principles are measured or represented, (which, in a certain point of view, may be considered to be the case,) we shall find them to stand in the order in which they have been above described; that is, the saccharine principles contain on an average from forty to fifty per cent. of carbon; the albuminous (including azote) from fifty to seventy-five per cent.; and the oleaginous about eighty per cent. of this principle. Of these principles it has already been remarked, that without any alteration in their essential composition, they are capable of assuming an infinite variety of modified forms: many of which are so peculiar, that from their sensible properties it is very difficult to recognise their identity. Moreover, these staminal principles, in all their forms, are capable of readily passing into, and of combining with, each other; at least the organic agents, as we shall see hereafter, have the power of effecting such changes. Further, these staminal

* The composition of the albuminous and of some of the oleaginous principles will be stated when we come to speak of the blood and biliary principles.

principles are all susceptible of transmutation into new principles according to certain laws ; thus the saccharine principle is readily convertible into oxalic acid ; or under other circumstances, into modifications of the oleaginous principle, as alcohol, &c. Though an endless variety of these modifications of the staminal principles exist in different organised beings, still the proportion they bear to the staminal principles is very limited ; and they are either confined to glandular secretions, or are excrementitious, or extravascular ; that is, these modifications and combinations form no part of the living animal, though they are often attached to it ; as in the case of shells, &c. of the molusceous tribes. They also exist in many excreted products.

From this essential identity between the alimentary matters by which animals are nourished, and the composition of their own bodies, it not only follows that in the more perfect animals all the antecedent labour of preparing these compounds *de novo*, is avoided ; but that a diet, to be complete, must contain more or less of all the four staminal principles. Such at least must be the diet of the higher classes of animals, and especially of man. It cannot indeed be doubted that many animals, on an emergency, have the power of forming a chyle from one or two of these classes of aliments ; but that the higher animals can be so nourished for an unlimited time is exceedingly improbable. Nay, if we judge according to what is known from universal observation, as well as from experiments which have been actually made by physiologists regarding food ; we are led to the directly opposite conclusion, namely, that the more perfect animals could not exist on one class of aliments ; but that a mixture of three at least, if not of all the four staminal principles, is necessary to form an alimentary compound well adapted to their use.

This view of the nature of aliments is singularly illustrated and maintained by the familiar instance of the composition of milk. All other matters appropriated by animals as food, exist for themselves ; or for the use of the vegetable or animal of which they form a constituent part. But milk is designed and prepared by nature expressly as food, and it is the *only material* throughout the range of organisation that is so prepared. In milk, therefore, we should expect to find a model of what an alimentary substance

ought to be—a kind of prototype, as it were, of nutritious matters in general. Now every sort of milk that is known, is a mixture of the four staminal principles we have described ; in other words, milk always contains, besides water, a *saccharine* principle ; a *caseous*, or strictly speaking, an *albuminous* principle ; and an *oily* principle. Though in the milk of different animals, the three latter of these staminal principles exist in endlessly modified forms, and in very different proportions ; yet neither of them is at present known to be entirely wanting in the milk of any animal.

The composition of the substances by which animals are usually nourished, favours the mixture of the primary staminal alimentary principles ; since most of these substances are compounds of at least three of the staminal principles. Thus most of the gramineous and herbaceous matters, besides water, contain the saccharine and the glutinous principles ; while every part of an animal contains at least albumen and oil. Perhaps, therefore, it is impossible to name a substance constituting the food of the more perfect animals, which is not essentially a natural compound of at least ~~two~~, if not of all the four great principles of aliment.

In the preceding sketch we have attempted to give a general notion of the groundwork of organized products, and of their relations to, and dependence on, each other, when considered as aliments ; that is, as the means by which such organised products are themselves formed, and their existence maintained. This sketch, general and simple as it appears, if rightly understood and applied, will be found to remove much of that mysterious character, with which the processes of nutrition have been invested ; and by lessening the field of our inquiry, to bring us nearer our object. We had previously known, that the articles employed as food by animals, are essentially composed of three or four elements. But we have now learnt, that all the more perfect of those matters on which animals subsist, are compounds of *three or four proximate principles* ; all of which compounds except one (the saccharine) are in their essential characters, identical with the materials composing the frame of the animals themselves. We have also learnt, that owing to this identity of composition, many animals are saved the labour of forming these

proximate principles from their elements ; and have only to rearrange them as their exigencies may require. The task of forming the proximate principles is thus left to the inferior animals, or to plants ; which are endowed with the capacity of compounding these proximate principles from matters still lower in the scale of organisation than the animals and plants themselves. Hence there is a series, from the lowest being that derives its nourishment from carbon and carbonic acid, up to the most perfect animal existing : each individual in the series preferring to assimilate other individuals immediately below himself ; but having on extraordinary occasions the power of assimilating all, not only below but above itself, in the system of organised creation.*

* These views first publicly maintained by myself more than twenty years ago, are now (with a slight exception to be presently noticed,) generally admitted by Physiologists. For several years they attracted little attention, and probably would have been forgotten by the present generation, had they not been adopted and published by foreign philosophers, and particularly by the celebrated chemist Liebig ; with the addition of the startling hypothesis alluded to in a former page (459) viz., that the only use of the saccharine class of aliments is to form animal heat by combustion in the lungs. A recent author, Dr. R. D. Thomson, of Glasgow,* has ascribed these views to Beccaria ; and has referred to a paper published by him in 1742, in the *Histoire de l'Academie de Bologne, Collect. Acad. xiv.*, as an authority for the assumption. I have never read Beccaria's works ; but judging from the quotations given by Dr. T., I think they scarcely warrant the assumption drawn from them. Beccaria finding that the gluten of wheat resembles animal matters, and contains azote, asks, in consequence, "Is it not true that we are composed of the same substances which serve as our nourishment?" The answer to this question had it been followed out, would doubtless have established the present views ; but as neither Beccaria, nor any one else to my knowledge, made such an attempt, I do not see on what grounds these views can be ascribed to Beccaria ; any more than the discovery of the true nature of the diamond can be ascribed to Newton, because he most sagaciously inferred from some of its properties that it was combustible.

Again, the *metamorphoses of tissues* we read of in the works of modern chemical physiologists, and now generally admitted, are nothing more nor less than what I long before described under the head of secondary assimilating processes. See Section d.

* Med. Chir. Trans. vol. xxix. page 327.

SECTION C.

OF THE PROCESSES OF ASSIMILATION.

THE processes of assimilation, in the general sense in which we here use the term, include every process directly or indirectly concerned in the assimilation of the alimentary matters before mentioned, into the textures of a living animal body. In this sense of the term, therefore, the processes of assimilation may be divided into two great classes, which, from their relations to each other, may be termed the *primary* and *secondary assimilating processes*. The *primary assimilating processes* comprise the process of digestion, and all the intermediate processes up to sanguification, inclusive ; while the *secondary assimilating processes* comprise the processes by which the different textures of which the living body consists, are first formed from the blood ; and are afterwards re-dissolved and removed from the system. With these processes, as far as they are at present understood, we shall presume the reader to be acquainted ; our remarks, therefore, on the primary and secondary assimilating functions, in this and the following sections, will be principally confined to the mutual relations and subservicnes of the different processes to each other.

In the processes of assimilation, both primary and secondary, *water* plays so important a part, that before we procced, it becomes necessary to make a few remarks on the subject. Water enters into the composition of most organised bodies in two separate forms ; that is, water may constitute an *essential* element of a substance, as of sugar, starch, albumen, &c., in their *driest* states ; in which case the water cannot be separated, without destroying the *hydrated* compound. Or water may constitute an *accidental* ingredient of a substance, as of sugar, starch, albumen, &c. in their moist states, in which case, more or less of the water may frequently be removed without destroying the essential properties of the compound. Now a very large proportion of organised bodies (perhaps all those to which our present inquiry

rclates) contain water in both these forms ; both as an essential element and as an accidental ingredient ; and in most instances it is impossible to distinguish between the water that is essential, and that which is accidental, though the mode of union in the two cases must be altogether different.* Organised bodies containing small proportions of combined water are usually of a firm and stable character, and in common language are said to be *strong* or *high* ; while those containing larger proportions of combined water are usually of a delicate and unstable character, and are said to be *weak* or *low* ; thus we read of strong and weak sugars, glues, &c., varieties of these principles which are found to owe their peculiar properties to the less or greater proportions of combined water they contain. The processes of converting strong bodies into weak and *vice versa*, are with difficulty accomplished artificially ; for instance, though we can in some respects make a strong sugar weak, in no instance do we appear to be able to reverse the process, and to convert a weak into a strong sugar. As these processes, however, constitute some of the most frequent and important of all the processes of a purely chemical character taking place in organised compounds, it becomes necessary to distinguish them by appropriate appellations ; and for this purpose I have been long accustomed to indicate the change of a strong into a weak principle, by the term *reduction*, and *vice versa*, the change of a weak into a strong principle, by the term *completion*—a nomenclature which has been adopted throughout these pages, and which the reader is desired to bear in mind.

The *primary assimilating processes* viewed as a whole, and with reference to the chemical influence of water, as above described, may be considered of two kinds, directly opposed to each other. From the stomach to the duodenum inclusive, the operations are all of a *reducing* kind ; that is, the alimentary matters, however strong and firm, are gradually reduced by this first stage of the assimilating processes to the *lowest* possible condition,—to the tender and delicate state, as it were, of infancy. In this

* The reader is referred to the third book of my Bridgewater Treatise, for some further remarks on the subject of assimilation in general ; and particularly on the influence of water in modifying organised compounds.

low state, the alimentary principles enter the lacteals as chyle; and from this moment they again gradually begin to be *raised*, and to become stronger and firmer in their texture, till they reach the thoracic duct, where their properties are found to be considerably developed. From the thoracic duct they are poured into the general mass of blood, and immediately subjected to the action of the respiratory function in the lungs. During the respiratory process, they part with the remainder of their combined water, (which, as we have elsewhere attempted to show, is principally expelled from the lungs with the respiration air,)* and thus, being rendered *complete* in their properties, and identical in all respects with the blood itself, they are finally adapted for incorporation with that important fluid.

If we attentively consider the reducing portion of the assimilating processes, we shall find them to be of at least three kinds. In other words, the digestive organs, properly so called, exert a threefold function: First, the stomach has the power of dissolving alimentary substances, or of bringing them into a semifluid condition. This operation seems to be altogether chemical, and probably essentially consists in the combination of alimentary substances with water; that is, in *reducing* the alimentary substances from a high to a low condition. Secondly, the digested aliments, or the chylous portion of the chyme taken up by the lacteals, though the proportions of its different ingredients may vary, is always essentially the *same* in its composition. The digestive organs therefore, and more especially the stomach, must possess the power, within certain limits, of changing into one another the simple alimentary principles formerly described. This part of the operations of the stomach appears, like the reducing process, to be *chemical*; but not so easy of accomplishment. It may be termed the *converting* operation of the stomach. Thirdly, the crude and dead aliments undergo changes in the stomach, &c., which render them fit to be brought into contact and even in union with the *living* animal body; the stomach and assimilating organs, therefore, must possess the power of *organising* and *vitalising* the different alimentary substances. It is impossible to imagine that such organising agency of the stomach can be

* See Bridgewater Treatise, p. 470. 3rd edition.

chemical. This agency is *vital*, and its nature is completely unknown.

Of the solvent or reducing function of the stomach.—The different culinary processes, roasting, boiling, baking, &c., have all a reducing effect, and may, therefore, be considered as preparatory to the solvent action of the stomach. Of these operations man avails himself, and they constitute the chief means by which he is enabled to be omnivorous; for, without such preparation, a very large portion of the matters which he now adopts as food, would be completely indigestible. By different culinary processes, the most refractory substances can be often rendered nutritious. Thus, by alternate baking and boiling, the woody fibre itself is said to be convertible into a sort of amylaceous principle, not only possessing most of the properties of the amylaceous principle, but capable of being formed into bread * Nay, even the albuminous principle is probably rendered more nutritious (certainly better adapted to man in a civilised state,) by the judicious application of cookery; and the same remark might be applied to almost every other substance.

The solvent and reducing powers of the stomach may be thus illustrated. When a mass of solid albuminous matters merely triturated by the masticatory processes, arrives in the stomach, it speedily undergoes certain changes. The portion of the albumen in contact with the stomach soon begins to change its appearance, that is, it becomes softened, and assumes a sort of gelatinous character; by degrees, the peculiar action of the stomach brings the whole portion of the mass into successive contact with the living organ; and in this way at length the whole mass becomes softened or dissolved, and forms the compound termed chyme. Through all these apparent changes, however, the albumen has undergone no real change. What was introduced into the stomach as albumen, is still albumen in the chyme; at least chemists have so pronounced it. Yet the albumen has assumed an appearance altogether different. The albumen of the egg, and of the aliment, may be coagulated by heat into a firm and elastic solid. The albumen of the chyme (or chyle) is indeed coagulable by heat; but its coagulation is so

* Philos. Trans. 1827.

imperfect, and so wanting in tenacity, as to offer a striking contrast with the coagulated albumen of the egg. Now what could have happened during these changes in the stomach, but the more intimate connexion or combination of the albumen with water, by which the strong and firm *albumen ovi*, has been reduced to the weak and delicate *albumen chyli*, as formerly explained? And if this explanation be admitted with regard to albumen, it must be admitted with regard also to the other elementary principles.

Of the nature of the peculiar agency by which the combination of alimentary substances with water, and consequently their solution, is effected, we cannot be said to possess much certain knowledge. The combination appears to be chiefly owing to the agency of a fluid secreted by the stomach, the glands for the formation of which are most numerous about the pyloric orifice. By this secretion, or by some other agency exerted in the stomach, the previously masticated food which has been introduced into that organ, is associated with water, and thus becomes itself more or less a fluid. Of this important secretion of the stomach, *chlorine*, in some state or other of combination, is an ingredient—it would seem a *necessary* ingredient; for the secretion in its healthy state always contains more or less of chlorine, the powerful influence of which seems mainly to contribute towards affecting the combination of the aliments with water.*

* This was written long before I was aware of the recent experiments of Eberle, Schwann, and Müller on this subject. Eberle attempted to show that the digestive principle consists of a solution of mucus in an acid. Schwann and Müller found that Eberle was in error in his statement,—that all mucus in an acid state has the digestive property,—and showed that this property is possessed by an organised principle secreted with the gastric mucus only. This principle has been termed *pepsin*, and its action on the matters to be dissolved has been supposed to be somewhat analogous to the action of *dיאستاز* on starch. See Müller's Physiology, English Translation, page 543.

I have already mentioned that some recent writers both on the continent and in England have denied the presence of free muriatic acid in the stomachs of animals. Dr. R. D. Thomson, for instance, in the paper before alluded to, (see note, page 465), states that he could not find it; and from the mode in which he operated, I can readily believe him. I have so much confidence, how-

The chlorine thus so indispensable to the reducing process of the stomach, is perhaps more frequently the subject of derangement, than anything connected with the assimilation of the food. It often happens, that instead of chlorine or a little free muriatic acid, a large quantity of free muriatic acid is elicited, which not only gives occasion to much secondary uneasiness, but more or less retards the process of reduction itself. The source of this chlorine or muriatic acid must be the *common salt* which exists in the blood; to suppose that it is generated, is quite unnecessary. The chlorine, therefore, is separated from the blood, at least in part; and it may be demanded what is the nature of the agency capable of separating the chlorine from a fluid so heterogeneous as the blood? We are acquainted with one agent that exerts such a power, namely, electricity; and some modification of this agent may be supposed to be employed by the animal economy for its operations, in the same manner, and on the same principles, as the materials themselves are employed from which the animal body is constructed. Perhaps, therefore, the decomposition of the salt of the blood may be fairly referred to the immediate agency of some modification of this principle electricity. We say some *modification* of electricity; for we do not believe that electricity, precisely as we are acquainted with it, and as existing and acting in inanimate nature, can be thus employed; for the very urgent reason, that the products and operations of organised bodies, which are the results of its agency, differ altogether, as we have said, from those of inorganic bodies. Thus we could conceive common electricity to form or to decompose the crystallisable principles, sugar, or vinegar, or common salt; but we never could conceive it to form the organised principles, starch, or albumen; or even the peculiar combination of chlo-

ever, in my own experiments on this subject, the results of which were decided and unequivocal, that I cannot give up the point, and therefore have permitted the text to remain unaltered. Liebeg, in his recent work "Researches on the Chemistry of Food," page 139, has stated that lactic acid under certain circumstances is capable of decomposing common salt and setting the muriatic acid free. This may be the case, and the muriatic acid obtained by distillation of the gastric fluids may have been partly derived from this source; but the observation does not apply to my results. For the pathology of the lactic and muriatic acids the reader is referred to page 74 *et seq.*

rine existing in the stomachs of animals, on which, as we have said, the solution of the food depends; because the composition of these principles is not only different, but absolutely incompatible with the composition of the crystallisable principle formed by the agency, and agreeably to the laws of operation, of common electricity.

Supposing the chlorine or muriatic acid found in the stomach to be derived from the common salt existing in the blood and in the stomach, another question arises,—what becomes of the soda from which the muriatic acid has been separated? The soda remains behind, or is absorbed into the mass of blood, and a portion of it no doubt is requisite to preserve the weak alkaline condition essential to the fluidity of the blood. But the larger part of this soda is probably directed to the liver, and is elicited with the bile in the duodenum; where it is thus again brought into union with the acid, which had been separated from the blood in the stomach. These observations, illustrating the importance of common salt in the animal economy, seem to explain, in a satisfactory manner, that instinctive craving after this substance, which is shown by animals.

Admitting that the decomposition of the salt of the blood, &c., is owing to the immediate agency of a modification of electricity, we have in the principal digestive organs a kind of galvanic apparatus, of which the mucous membrane of the stomach and intestinal canal in general may be considered as the acid or positive pole, while the hepatic system may, on the same view, be considered as the alkaline or negative pole.* Whether such electrical action be admitted or not, (and the admission is of no very great importance,) what we have above stated may be received as a simple expression of the facts, in so far as they relate to the saline constituents of the blood. Moreover, be the nature

* This notion or opinion, which was first advanced by me many years ago, seems to have lately received some confirmation from the experiments of Matteuci, who found that when the liver and stomach of a rabbit were connected with the platinum ends of the wires of a delicate galvanometer, a deviation of the needle took place amounting to fifteen or twenty degrees. This action became very feeble, or entirely ceased, after the death of the animal: hence he inferred that it depended on the vital action of the organs, and not on the difference of the chemical properties of their secretions. Matteuci, l'Institute, No. 75.

of the energies what they may, by which these changes are effected; along with these changes, and probably by the aid of the same energies, other very important changes or processes are carried on, to some of which we shall have occasion hereafter to allude.

The separation of chlorine or of muriatic acid appears to be necessary to the reducing operation of the stomach in its healthy state; but other acids, and particularly the lactic acid, are always present during the digestive processes. Whether this lactic acid be essential to the digestive processes in man and in other animals in which it exists, does not appear to be clearly ascertained. My own opinion respecting it is, that though frequently present in the human stomach, it is, particularly when in excess, rather to be considered as the result of unnatural irritation,* produced by disease, indigestible aliments, &c., than as a healthy product *necessary* to the digestive process. The source of the lactic acid, also, is probably different in different instances. Sometimes it may be derived from the food; at other times, and that most frequently, it seems to be immediately derived, like the muriatic acid, from the blood itself. If the lactates exist in the blood, it may in part be derived from the lactates already formed in that fluid. There is, however, every reason to believe, that when very abundant, it is derived from the decomposition of the blood in the extreme vessels of the stomach, &c. We shall consider this point more in detail, when we come to speak of the secondary processes of assimilation in the next section.

Recent writers assert that free phosphoric acid, or at least an acid phosphate, exists in the stomach of animals during the digestive processes.

Another acid occasionally present in the stomach, and the result of unhealthy assimilation, both primary and secondary, is the oxalic acid. From the relation of this principle to the saccharine aliments in particular, there is no difficulty in conceiving how it may be occasionally developed in the stomach. Moreover, it is occasionally taken into the stomach as an alimentary matter, for instance, in the stalks of rhubarb, sorrel, &c. Small quantities of oxalic acid thus developed or introduced into the stomach, do not appear to give much uneasiness in that organ; and when introduced, it may in some instances, like other saccha-

rine derivatives, be assimilated. The effects of the oxalic acid are most severely felt in the subsequent vital processes ; and its development, more especially during the secondary assimilating processes, is commonly attended by formidable derangements of the health.

As to the butyric, acetic, carbonic, and other acids occasionally met with in the stomachs of animals ; these are probably in a great degree the results of indigestion, and derived from the mal-assimilation of the alimentary matters.

*Of the converting powers of the stomach, &c.—*Though the proportions of the different ingredients of the chyle, as ultimately formed, are liable to be varied according to the nature of the food ; yet, whatever the nature of the food may be, the general composition and characters of the chyle remain always the same. The stomach, therefore, must be endowed with a power or faculty, the agency of which is to secure this uniform composition of the chyle by appropriate action on such materials as circumstances may bring within its reach. Two indeed, of the chief materials from which chyle is formed, namely, the albuminous and oleaginous principles, may be considered to be already fitted for the purposes of the animal economy without undergoing any essential changes in their composition ; but the saccharine class of aliments which form a very large proportion of the food of all animals, except those entirely subsisting on flesh, are by no means adapted for such speedy assimilation. Indeed, one or more essential changes must take place in saccharine aliments previously to their conversion either into the albuminous or the oleaginous principles.

Under *ordinary circumstances*, the essential changes which alimentary matters undergo in the stomach, are most probably altogether chemical. That is, the changes are such as do take place, or rather such as would take place, if the elements of the substances thus changed in the stomach, could out of the body be so collocated as to bring into action the affinities necessary for the changes produced in the stomach. Thus, as we know, the saccharine principle spontaneously becomes alcohol, which is merely an oleaginous body of a weak kind. When, therefore, in the stomach it is requisite that sugar be converted into oil, it is probable that the sugar passes through precisely the same series

of changes it undergoes out of the body during its conversion into alcohol. We cannot trace the conversion of sugar into albumen, because we are ignorant of the relative composition, and of the laws which regulate the composition of these two substances. The origin of the azote in the albumen is likewise at present unknown to us, though in all ordinary cases it seems to be appropriated from some external source.* That the oleaginous principle may be converted into most, if not all, the matters necessary for the existence of animal bodies, seems to be proved by the well-known fact, that the life of an animal may be prolonged by the appropriation of the oleaginous and other matters contained within its own body.

Under ordinary circumstances, then, the converting powers of the stomach must essentially consist of the three kinds mentioned, viz. the conversion of saccharine aliments into albuminous and oleaginous principles; the conversion of albuminous principles into oleaginous principles; and the conversion of oleaginous into albuminous principles. These three forms of the same function may in fact be considered as so many subordinate functions, each distinct in its characters, and each liable to be affected by disease, &c., independently of the others. Of these three subordinate functions, the first, viz. the conversion of saccharine into albuminous and oleaginous aliments, is by far the most important. And as the appropriation of saccharine aliments is not only common to many animals, but even to vegetables, it may perhaps be viewed as the lowest step of alimentary renovation; in other

* The azote may, in some instances, be derived from the air, or generated. But my belief is, that under ordinary circumstances, much of the azote employed in the assimilation of saccharine matter is furnished by a highly azotised substance secreted from the blood chiefly into the duodenum; and that the portion of the blood thus deprived of azote is separated from the general mass of blood, either by the stomach in the form of lactic acid, or by the liver, as one of the non-azotised constituents of the bile; and that the lactic acid and non-azotised substance thus separated are ordinarily excrementitious. The above circumstances mentioned in the former edition of this work, I still think probable; and long and repeated attention to the functions of the liver both in health and in disease, have satisfied me that this organ in its assimilating functions, is analogous to, or identical with the assimilative functions of vegetables; that the liver represents, in short, the original vegetative system, on which in animals, the animal system is, as it were, superimposed. See some further remarks on this subject at the end of the next section.

words, as constituting the immediate act, as it were, by which the stamina or groundwork of organised beings is formed. Hence, though the appropriation of saccharine aliments by animals, must be a very different process from the appropriation of such aliments by plants ; yet it is probable, that in those animals destined to subsist, in a greater or less degree, on saccharine aliments, such power of appropriation is more firmly established, (in the liver ? see preceding note,) than the appropriation of albuminous and oleaginous principles. In short, that the power of appropriating the saccharine principle is the last that ceases to exist in an animal ; and thus often remains to a certain extent long after the power of appropriating albumen and oil has ceased. The derangement or partial suspension of the power of converting the saccharine principle in man, not only constitutes a formidable species of dyspepsia ; but the unassimilated saccharine matter, in passing through the kidneys, gives occasion to the disease termed *diabetes*.

The reader will have remarked, that we have frequently used the term *ordinary circumstances* ; and perhaps it may not be amiss to explain the meaning attached to that term.

When an animal is duly fed, according to that diet which is natural to it, and for which its organisation has been adapted ; a regular and *ordinary* series of changes takes place within the animal, and the alimentary matters are converted into chyle. But one general characteristic of organised beings is, that within certain limits, and for a certain time, animals possess the power of varying their habits and of accommodating themselves to circumstances. Under *extraordinary* circumstances, therefore, extraordinary changes must and do take place. In some instances, these changes out of the ordinary course are to an extent altogether astonishing, and such as defy our utmost calculation. The assimilating organs appear even to decompose principles which are still considered as elementary, and thus to *convert* them into azote or carbon ; so that it is impossible to define what, on an emergency, these organs are capable of doing. But what is thus done on an emergency, will usually be found to constitute an exception to what is done in ordinary ; their ordinary mode of action being always that which is *most simple.**

* Were it not for some such accommodating faculty as that mentioned in

Of the organising and vitalising powers of the stomach, &c.—
In this part of our investigation we meet with the real difficulties we have to overcome in explaining the operations of living beings. The whole of the great and essential changes which alimentary matters undergo, may, and perhaps will, be traced by care and attention ; but all beyond will probably for ever remain unknown to us. Now at least, though we understand in some degree the chemical changes, of the vitalising influences, we in truth know absolutely nothing. There is, however, every reason to believe, that vitality is imparted through the agency of the living animal itself. For though, from the natural composition of alimentary substances, they be to a certain extent fitted for the purposes of the animal economy, yet alone they are incapable of uniting themselves with the living animal frame ; and unless the living economy contribute likewise its share, by re-arranging or otherwise adjusting those minute quantities of incidental principles peculiar to organised products, the future work of assimilation will be incomplete or impossible.

To the present head must be referred all those operations of matters incidental to alimentary substances, and of medicinal agents, &c., which cannot be explained on common mechanical or chemical principles. These incidental matters, medicinal agents, &c., interfere with the processes of vitality in modes we do not understand, and therefore can neither anticipate nor control. We can form no conception, for instance, why mutton should prove a poison to a certain individual.* We know that mutton is essentially composed of albuminous

the text, animal existence would not only become precarious, but in many instances, impossible.

* I knew an instance of the illustration mentioned in the text. The individual could not eat mutton in any form. The peculiarity was supposed to be owing to caprice, and the mutton was repeatedly disguised, and given unknown to the individual ; but uniformly with the same result of producing violent vomiting and diarrhoea. And from the severity of the effects, which were in fact those of a virulent poison, there can be little doubt, that if the use of mutton had been persisted in, it would have soon destroyed the life of the individual. Similar effects are well known to be produced in certain instances by many articles used both as food and medicines ; but this is the only instance which has come to my knowledge, in which mutton has so acted.*

and oily matters, like other meats which such individuals take with impunity. The peculiar effects of mutton, therefore, cannot depend on the mere albuminous and oily principles, but must depend on those principles infinitely minute in quantity, incidental to mutton, and on which its peculiar sensible properties depend. We do not know the exact nature of these incidental principles on which the peculiar properties of mutton depend ; and even if we did know their exact nature, we should be probably quite unable to form a notion of their peculiar mode of operation in the production of the effects in question. The nature of these operations, therefore, as well as the nature of the operation of many medicinal agents, must for ever remain concealed.

The preceding observations relate more especially to the assimilating operations taking place in the stomach. With respect to the operations which take place in the duodenum, it may be observed, that though the phenomena vary considerably according to the nature of the food, so far as we can understand these phenomena, under every change of food the essential character which the chyme undergoes in the duodenum is unaltered. That is, the acid developed in the stomach, combines in the duodenum with the alkali of the bile, and is more or less neutralised, (perhaps entirely neutralised in a healthy condition of the organs;) the albuminous principles, if not before developed in the stomach, make their appearance ; and the matters destined to be excrementitious are more or less perfectly separated. Of the nature of the more recondite and vitalising changes which take place in the duodenum, we are in the same state of complete ignorance, as we are of the similar changes which take place in the stomach.

In the foregoing remarks on the different processes which take place in the stomach and duodenum, and which are necessary for the conversion of the food of an animal into the living materials of its body, we have endeavoured to distinguish between what, to a certain extent, is within our powers of comprehension ; and what is completely beyond them. Moreover, it may be observed, that though the three great and essential processes of digestion, viz., the reducing, the converting, and the organising processes are sufficiently distinct from each other ; yet it is not to be under-

stood, that they take place in succession, or in the order in which they have been described. The fact is, that all these processes go on at the same time; and as soon as a portion of food begins to be dissolved, its future changes seem to be determined. If it be necessary that the portion of food undergo an essential change, that change is accordingly begun. If no such change be required, the organising process itself begins simultaneously with the reducing process. The consequence of this union of the digestive processes is, that the staminal principles are all developed in the chyle, as soon as the excrementitious matters are separated by the biliary and pancreatic fluids.

It remains to make a few remarks on those changes which take place after the chyle has entered the lacteals.

We have already stated, that the moment the chyle enters the lacteals, it begins to be subjected to a series of processes of a nature totally different from those it had undergone in the stomach and duodenum. In the stomach and duodenum, the leading processes, generally speaking, had been of a *reducing* character; in the lacteals, the leading process is of an opposite or *completing* character; and the water which had been associated with the albuminous and oleaginous principles in the first stages of assimilation, in the second stages is again gradually removed. In other words, the properties of the chyle as it passes through the lacteals, and the glandular apparatus connected with these vessels, gradually approximate to those of the blood.

Whether the *converting* process takes place in any form or degree in the passage of the chyle through the lacteals, has not been ascertained. As, however, the *cast* of the chylous principles seems, as formerly stated to be determined in the early stages of assimilation, the probability is against the supposition, that under ordinary circumstances, any chylous principle is *converted* into another during the passage of the chyle through the lacteals. Besides the *completing* process, therefore, the only other great change to which the chyle is subjected in the lacteals, is the *vitalising* or *organising* process. Now, the chyle, in the minute state of subdivision to which it is subjected in the lacteals, is most favourably circumstanced for undergoing the vitalising processes; every particle of it being, as it were, brought into immediate contact with the living and exquisitely

organised structure of the lacteal apparatus. In proportion, therefore, as the combined water of the chyle is separated, may vitality be said to be associated with the chylous molecules, till they are fitted to become component parts of the living body.

The above being little more than a simple expression of facts, as they present themselves to our notice, may be considered as very imperfect and unsatisfactory. The charge must be admitted; but in reply we must observe, that the little stated, imperfect as it is, constitutes the whole that we can be said to actually know on the subject at present.

Having briefly traced the assimilating processes through their primary stages, and endeavoured to point out the leading changes which the alimentary matters undergo during their conversion into blood; we have in the next place to consider the changes which the blood itself subsequently undergoes, during its conversion into the living constituent principles of animal bodies.

SECTION d.

Of the Secondary Assimilating Processes.

As the term *secondary assimilation* is novel in the sense in which it is employed in the present volume, it may in the first place require a brief explanation.

We have already stated, that under the head of secondary assimilation, we arrange all assimilating processes, subsequent to those of sanguification. The secondary assimilating processes, therefore, include two great divisions, which, for the sake of distinction, may be termed the *formative* and the *destructive*. Under the head of the secondary formative assimilating processes, are included the different processes by which the principles of the blood are converted into the different tissues composing animal bodies, as well as the different secretions designed for ulterior purposes in the economy; while under the head of secondary destructive assimilating processes are included the extinction (secondary digestion) of the different tissues of the body, and their

conversion, either into new principles designed for ulterior purposes; or into disorganised products designed to be removed from the body; or more frequently into products belonging to both these classes of substances.

Before we proceed to make a few remarks in detail on these two divisions of the assimilating processes, it may be proper to explain briefly the general principle on which the different processes are conducted. When a definite substance like the albumen of the blood, for instance, is converted into one or more new principles, either the entire elements composing the albumen must be re-arranged so as to produce a principle having new and different sensible properties; or what appears to be infinitely more common, and indeed the rule, the elements of the simple principle must be so arranged as to form *two* (or more) principles, either of which may be said to be *complementary* to the others; that is, the composition of one (or more) of the new principles must be such, as, in conjunction with the remaining principle, will *complete* the albumen, from which all the new principles were originally formed.*

Complementary decomposition is at least of two kinds; a substance may be changed into a new principle designed for ulterior purposes, and another principle designed to be excrementitious; *e. g.* albumen may be decomposed into gelatine, and hydrated carbon capable of becoming carbonic acid on exposure to air in the lungs. Or a substance may be decomposed into two principles, both of which may be designed for ulterior, or both for excrementitious purposes. Instances, perhaps innumerable, of these two forms of change are constantly taking place in the animal economy; though the first seems more naturally to belong to healthy action; the second to disease. Thus albumen and

* The part that water plays in complementary decomposition is often very important, and, to prevent misconception, deserves to be noticed. The original substance to be decomposed is often decomposed + or — water; that is, the complementary principles into which a substance is decomposed, do not exactly make up the substance as it usually exists, but the substance, plus or minus, one or more proportions of water. This circumstance is of such frequent occurrence in organic decompositions, as almost to constitute the rule rather than the exception.

gelatine are converted into principles, one or both of which are applied to further uses in the economy; whereas, in peculiar states of disease, gelatine in particular appears to be almost wholly converted into some modification of the saccharine principle and urea; both of which from their properties may be considered as excrementitious.

We have alluded above to the decomposition of a principle into three or more complementary principles, and many such decompositions doubtless take place in the animal economy, though they are at present little understood. As an instance, gelatine may be mentioned; which, instead of being decomposed into some form of the saccharine principle and urea, may be, and often is, converted into oxalic acid and the *carbonate of ammonia*.

The above remarks on complementary decomposition are chiefly applicable to the *essential* elements of which organised bodies consist. How far they are applicable to the mineral elements *incidentally* present in organised bodies is not known; and the following may be said to comprise almost the whole of the little at present understood on this part of the subject.

The incidental mineral matters found in organised bodies, are supposed to be as fixed and definite, both in their nature and quality, as the essential elements of which such bodies consist. Hence, as the geologist is often enabled to identify strata by the similarity of the fossils imbedded in them; so the physiologist is enabled to identify organised tissues, by the similarity of the incidental mineral matters they usually contain. Thus the nervous mass is characterised by the presence of phosphorus; a peculiar tissue intimately connected with the nervous, by the presence of magnesia; certain submucous tissues, by the presence of lime, &c.*

* Some imagine that the mineral incidental principles of organised beings are generated during the vital processes; while others maintain that they are derived *ab externo*. My belief is, that under certain extraordinary circumstances, the vital agents can form what we now consider as elements; but that, in ordinary, such elements are chiefly derived *ab externo*, in conjunction with the alimentary principles. Late researches seem to shew, that in vegetables in particular, inorganic matters having certain chemical relations, may be occasionally substituted for each other.

We know little or nothing of the modes in which mineral incidental matters enter into the composition of organised products; but I agree with Berzelius in general, that such incidental matters usually exist in organised products in their elementary condition, and not as binary compounds; and that they assume the form of binary compounds or oxides, in which they commonly appear, during the destruction of the organised principle. On such occasions the oxygen or other essential element of the binary compound, may be derived from the organised principle itself; from the decomposition of water; from the atmosphere, &c.

The important practical inferences we wish to deduce from the preceding remarks are, that when incidental mineral matters appear as binary compounds among organised products, the mal-assimilation or destruction of organised tissues is not only indicated; but the exact nature of the tissue thus mal-assimilated or destroyed, may be predicated from the nature of the binary mineral compound.

In further illustration of these inferences it may be observed, that as alimentary matters consist in general of organised products, it is probable that the matters incidental to alimentary matters, (at least such as are congenial to the nature of the individual,) are appropriated along with the essential elements in the primary assimilating processes. On the contrary, when the alimentary matters are *not* congenial to the individual, or when, for some other reason, they are not primarily assimilated, alimentary matters are often converted into crystallisable principles; and the incidental mineral matters at the same time are emancipated in binary forms, and sometimes make their escape in large quantities, either into the intestines, or through the kidneys, &c.

The same circumstances may be supposed to take place in a somewhat different manner during derangements of the secondary assimilating processes. Thus in the secondary formative assimilating processes, when the albumen of the blood, instead of being converted into gelatine, &c., is converted into urea and a saccharine principle, the incidental matters of the albumen are necessarily set free, and make their escape as excrementitious matters; again, during the secondary destructive processes, the gelatinous

tissues, instead of being converted into principles adapted for ulterior uses, may be converted into urea and a saccharine principle, and the incidental matters escape, as before, in binary forms among the other excrementitious principles.

After these general remarks, we proceed to make a few observations on the leading formative and destructive processes of secondary assimilation.*

Gelatification is that process, by which a certain portion of the fluid albuminous principle of the blood is converted or assimilated into the solid gelatinous tissues of living beings. The gelatinous tissues may be considered as the most important tissues of their kind in animal bodies—as the groundwork, or staminal and fundamental texture on which all the other tissues rest, and from which, perhaps, some of them are elaborated. The process of gelatification takes place in the extreme capillary blood-vessels, and at the moment when the arterial is converted into venous blood; a phenomenon, therefore, intimately connected with, if not in some degree dependent on, the gelatificating process. This connexion of gelatification with the respiratory process, at once stamps its importance, and shows that the one process cannot be deranged or cease, without the derangement or cessation of the other. We have elsewhere endeavoured to point out the nature of some of the changes which take place during gelatification, and attempted to show, that when albumen is converted into gelatine, carbon is eliminated, which carbon (partly perhaps in a hydrated, partly in an oxygenated form,) remains associated with the venous blood till its arrival in the lungs; where, by combining with the oxygen of the atmosphere, it becomes fully oxygenated, and is converted into carbonic acid gas; in which form it makes its escape from the body.†

The next great secondary process, which goes on in the extreme capillary vessels simultaneously with the gelatificating processes, is *albumification*; a term expressive of the process or processes by which the *fluid* albuminous principles of the blood are

* Strictly speaking, the terms here used ought to be *gelatinification* and *albuminification*, but the abbreviated terms in the text have been adopted for their greater convenience.

† See Bridgewater Treatise, page 473, third edition. *

converted into the *solid* albuminous tissues of living bodies. Albumification, therefore, includes albumification properly so called ; or that process by which the albumen of the blood is converted into the albuminous textures of the body ; and *fibrification*, or that process by which the fluid fibrin of the blood is converted into the solid muscular fibrin of animals. During these processes, *water* must be eliminated ; but of the nature of the concurrent changes, we are at present ignorant ; though there is every reason to believe that they are of a most important character.*

The changes which the oleaginous matters of the blood undergo during the secondary formative assimilating processes, can hardly be stated ; further, than that before such fatty matters are laid up in their appropriate tissues, they undergo certain depurating processes, among which the separation of water appears to be one of the most important.

Another class of processes of the formative kind, belonging to the secondary assimilation, some of which are connected more especially with gelatification, others with albumification, are the formation of solid matters, as of bones, horns, hair, &c., &c. While still another class may be supposed to include the different *fluid* secretions derived from albuminous and oleaginous matters, and destined for ulterior purposes ; such as the saliva, the different gastric secretions, the spermatic fluid, various oily or resinous secretions, &c. With these, however, we have at present nothing to do ; we pass on, therefore, to the consideration of the processes belonging to the other general division of the secondary assimilating processes, those namely of the *destructive* kind.

By the secondary assimilating processes of the *destructive* kind are meant, as before explained, those processes by which the different tissues of the body are *unmade*, and are either converted into principles of a higher order, designed for ulterior purposes ; or into effete and crystallisable matters designed to become excreted from the system.

Of the ulterior changes of the gelatinous tissues.—Whether

* The *solidification* of the fluid albuminous materials of the blood into the gelatinous, albuminous, and fibrinous tissues, in the extreme capillary vessels, is probably one immediate source of animal heat.

the gelatinous tissues ordinarily undergo changes, by which they are converted into materials of a higher kind, is not accurately known ; but my belief is, that in a perfectly healthy condition of the system they do to a certain extent. Into this part of the subject, however, it does not concern us at present to inquire, and I have to chiefly notice the more apparent, as well, perhaps, as the more common, ulterior changes to which these and the other tissues are subjected during their extinction and removal from the economy.

From observation, and a variety of reasons which the practical nature of this treatise prevents me from entering on, I have long been of the opinion already repeatedly alluded to, that one mode in which the gelatinous tissues become effete, is by their conversion into two classes of complementary principles, of which urea, or its equivalent, constitutes one principle ; and the saccharine principle in some of its forms, (most frequently in the form of lactic acid,) the other. Both these classes of complementary principles escape by the kidneys in their crystallisable forms, particularly the urea, which escapes in large quantity ; the lactic acid escapes, also, from the skin, and from other parts of the body.* To a certain extent, these secondary destructive assimilating changes, which the gelatinous tissues undergo, appear to be natural ; they only become a source of mischief when they are excessive, or otherwise abnormal or diseased ; e.g. when the urea is converted into the carbonate of ammonia, or the saccharine principle into oxalic acid, &c.

Of the ulterior changes of the albuminous principle. The ulterior changes which the albuminous tissues undergo, are little understood ; I believe them, however, to be equally if not more important than those changes which the gelatinous tissues undergo under similar circumstances. I mean, of course, in part only ; for that certain portions of the albuminous tissues are destined in the healthy subject to become effete, and to be removed from the system during the secondary destructive assimilating processes,

* Liebig does not deny that lactic acid exists in the urine in disease, but asserts, as we have before noticed, that it does not exist in *healthy* urine. His notion is, that it is converted into carbonic acid in the lungs. We shall revert to this subject.

there cannot be a doubt; and the question is, in what forms such effete albuminous matters are eliminated from the system? In reply to this question I may observe, that a great many circumstances, which, for the reasons above mentioned, I cannot detail, have led me to the opinion, that *one* of the crystallisable principles thus formed from albumen during the secondary destructive assimilating processes, is lithic acid, most usually in the state of lithate of ammonia. The class of substances complementary to the lithate of ammonia appear to consist of certain ill-defined principles, to some of which we shall have occasion to allude in a subsequent part of the present Book. When the formation of lithic acid or its compounds becomes excessive, or when the compounds of lithic acid become decomposed, they prove a source of disease. There is reason also to believe that many formidable diseases are occasionally connected with the destructive mal-assimilation of the albuminous principles; from which principles various matters of a highly deleterious character, and related to the poisonous principle cyanogen, as a basis, may be readily supposed to be eliminated.

Albuminous matters differ in some respects from the gelatinous, inasmuch as gelatinous matters do not exist during the primary assimilating processes. This observation is made for the sake of stating,—what will be considered in the next section,—that a very large proportion of the lithate of ammonia found in the urine on common occasions, appears to be developed from the imperfect albuminous matters formed during the primary assimilating processes; and that it is only in deep-seated affections involving the whole system, that the lithate of ammonia is developed during the secondary assimilation of the albuminous tissues.

Of the ulterior changes of the oleaginous principle, we know still less, perhaps, than of either of the other staminal principles. The large proportion of oleaginous matter which enters into the composition of the nervous mass, shows the important part which oleaginous matters perform in the animal economy; and the disappearance of fat during the process of hibernation, and under many other circumstances, indicates that this principle is most extensively appropriated during the secondary destructive assimilating processes.

We have already alluded to the changes which the incidental mineral matters found in organised beings appear to undergo during the assimilating processes both primary and secondary ; and we have only to remind the reader, that the presence of large quantities of these incidental matters in the urine or elsewhere, must indicate unusual havoc among the various tissues to which they respectively belong ; which unusual havoc is probably referable, in a great degree, to an increase in the destructive processes peculiar to the secondary assimilation.

SECTION e.

Of the General Pathology of the Primary and Secondary Assimilating Processes.

MUCH of what we have to say on this part of the subject has been already mentioned or alluded to ; we shall, therefore, confine our remarks to a brief statement, chiefly by way of illustration, of the general facts connected with the inquiry.

The reader will bear in mind that the object of the primary assimilating processes is sanguification ; while the object of the secondary assimilating processes is the formation from the blood of the different organised tissues composing animal bodies ; we may therefore conclude, that the phenomena attending the mal-assimilation of the blood, must vary considerably from the phenomena attending the mal-assimilation of the different organised tissues ; and consequently, that though the mal-assimilation of the blood necessarily leads to the mal-assimilation of the organised tissues, the two classes of affections require a separate consideration.

Of primary mal-assimilation.—Primary mal-assimilation may occur—*a.* during the digestive processes taking place in the stomach ; *b.* during the processes taking place in the duodenum ; and

c. during the subsequent processes taking place in the chyliferous system ; or in all these localities simultaneously.

a. Mal-assimilation during the *digestive* processes, may more especially belong to the reducing, the converting, or the vitalising functions of the stomach ; and as the circumstances and symptoms attending these different forms of mal-assimilation are often very different, we shall briefly discuss them separately.

Mal-assimilation more frequently commences with derangement of the *reducing* process of the stomach, than perhaps with any other; and the presence of such derangement, may in general be recognised by symptoms more especially referred to that organ. When any substance incapable of being reduced or dissolved is taken into the stomach, even in its healthy condition, one of the first effects produced is the secretion from the stomach of a large quantity of acid, of which the *lactic* acid appears to constitute a chief ingredient. The immediate effects of this extrication of acid are felt both locally and remotely, in various ways. As far as the stomach is concerned, acidity is generally indicated by uneasiness or pain, (*gastralgia*,) more or less severe ; and by flatulence and spasm. After producing more or less of suffering, the acid indigestible matters, in some instances, are rejected by vomiting ; at other times, they pass into the bowels, and derange the whole alimentary canal, by producing diarrhoea, colic, &c. Derangements of the reducing process, necessarily lead to derangements of all the subsequent processes ; for what is not reduced or *dissolved*, can never be *converted*, much less *vitalised*. It becomes, therefore, of the very utmost importance to organised beings, that this important preliminary function should be well performed ; and that aliments should be carefully adjusted to the powers of this function whenever debilitated or otherwise disordered.

Besides being a necessary consequence of derangements of the reducing function above mentioned ; derangements of the *converting* function occasionally constitute an original disease, the effects of which are still more formidable than those arising from disordered reduction. Thus in diabetic affections, the reducing function in the stomach seems, in some instances, to be almost morbidly active ; and farinaceous and even other matters are reduced to the condition of low saccharine matter, which the con-

verting function of the stomach is incapable, as in health, of changing into the elements of chyle or blood. The consequence is, that this reduced or dissolved saccharine matter is taken up with the little chyle that may be formed ; and after producing various derangements in its transit through the system, is ejected with the urine. Again, the converting process may be *wrongly* performed ; the saccharine matter, for instance, instead of being converted into chyle, may be converted into oxalic, lactic, or other acid and deleterious matters, which may not only produce much local discomfort, but serious disorder in their subsequent passage through the sanguiferous system and kidneys ; or even through the bowels. In these, and a variety of other similar derangements, the vitalising and all subsequent processes are of course suspended, as far as regards matters which have thus been mal-converted.

But even supposing the reducing and converting functions of the stomach to be performed, the third or *vitalising* function may in some instances, be suspended or otherwise deranged. Thus, when more food is taken by healthy individuals, than is required for the purposes of the animal economy, there is reason to believe, that however perfectly the superfluous portion of the aliments may, for the sake of enabling them to pass through the system without producing great disorder, be dissolved and converted, the vitalising function is withheld ; and that such superfluous matters are finally elicited either with the bile ; or, in the form of lithate of ammonia, in the urine. Of course also, as above mentioned, the vitalising process never takes place in matters which have been imperfectly reduced, or mal-converted.

b. Primary mal-assimilation in the duodenum appears to be more generally the result of mal-assimilation in the stomach, than an original state of disease. At any rate we may, in the first place, consider those errors taking place in the duodenum, which originate more immediately from stomachic derangements. When the reducing process in the stomach has been imperfectly performed, we have stated that a large quantity of acid is not only derived from the decomposition of the salts of the blood, but actually *generated*. The acid generated is usually the lactic acid, or some other acid of a destructible character, and may be either derived from the blood, or from the food, or from both sources.

But from whatever source derived, it is obvious, that unlike the muriatic acid derived from the decomposition of common salt, it can have no equivalent of alkali with which it may again combine and become neutralised in the duodenum. The acid contents of the stomach, therefore, on reaching the duodenum, do not as in health, become neutral, but remain more or less acid ; which unnatural acidity not only produces great uneasiness in this important part of the alimentary canal ; but often excites derangement throughout its whole course. Nor is this the only result ; there is every reason to believe that a portion of the acid thus developed is absorbed with the chyle, and interferes with the due completion of that important fluid. In slighter cases of a temporary character, the effects pass off, and all becomes right again ; but in severe and protracted cases, arising from derangements of the digestive organs, connected with inveterate constitutional diseases, or from long exposure to strong exciting causes, as malaria, &c., the case is different ; and the acid and unnatural matters make their way from the chyliferous system into the abdominal veins ; the blood in which vessels often becomes quite black, and sometimes acid. Now as this unnatural blood passes through the hepatic system, the functions of the liver become disordered, and the bile, if not actually rendered acid, at least loses its neutralising properties ; and thus the mischief becomes perpetuated. An extreme case is here supposed for the sake of illustration ; such, perhaps, as occurs in the remittent fevers of tropical climates only ; but similar phenomena appear in an infinite variety of forms and grades, as the results of mal-assimilation, in all climates. The reader also is desired to observe, that for the sake of rendering the illustration more distinct, one acid, the lactic acid, only is spoken of ; but in conjunction with the lactic acid, under such circumstances, it is to be understood that a variety of other unnatural matters of a complementary character, many of them of an acid, perhaps of a poisonous character, must likewise be generated, and thus contribute, in various ways and degrees, to aggravate the disorder.

Of mal-assimilation peculiar to the duodenal function, we do not know much of a positive character ; but if we may judge from the phenomena, instances of such derangements are rare, compared with those above mentioned originating in the stomach

and liver—in other words, the duodenum appears to be little more than the field or arena in which the results of prior derangements in the stomach, and the subsequent derangements of the hepatic system, are conjointly displayed.

c. Of the nature of primary mal-assimilation in the lacteal system, we can say but little; though I believe its effects are most important; especially in the earlier periods of life and adolescence, when this part of the assimilating processes seems to be particularly defective. We have already mentioned, that when too much food is taken relatively to the assimilating powers of the stomach, or to the wants of the system, that in the healthy states of the assimilating organs, such superfluous matters are often reduced and converted, and even perhaps partially vitalised, so as to pass with the chyle into the sanguiferous system; from whence, (not having been sufficiently vitalised, or not being required,) they are ejected from the system through the *healthy* kidney, in the form of lithate of ammonia. Now, in early life, under such circumstances, from some causes which I do not profess to explain; but probably from causes connected with original weakness or deficient action of the assimilating organs and of the kidneys; or rather, in short, of the whole system; the imperfectly assimilated chyle, in passing through the lacteal system, either does not undergo the necessary changes by which chyle is converted into blood; or is mal-converted into the comparatively insoluble pseudo-albuminous matter of struma; which in passing through the lungs lays the foundation (perhaps at first mechanically) of tuberculous deposition, and future accretion. Whether or not this be admitted, I believe no one will deny who has studied the subject, that about the age we are now considering, the assimilating organs in strumous and consumptive habits are peculiarly deranged; and that great attention to diet, &c., at this age, (when diet is least apt to be attended to, and all sorts of crudities are taken,) will not only sometimes ward off those phthisieal attacks, which, when once established, will inevitably run their fatal course; but prevent many nearly allied diseases in after life.*

* Strumous, lithic acid, and gouty diseases, are all the results of mal-assimilation of the albuminous principle, either primary or secondary; and often gradually run into each other. Thus gout and struma are frequently, if not

After this brief illustrative sketch of the consequences of primary mal-assimilation, we proceed, in like manner, to illustrate the derangements of the secondary assimilating processes.

The reader will bear in mind that the secondary assimilating processes differ from the primary, inasmuch as all the principles both produced and operated on, are fixed and limited; and that the processes are of two kinds, denominated formative and destructive, *i. e.* consist of processes by which the principles of the blood are formed into the different tissues of the body; and of processes by which these tissues are again destroyed, and either converted into other principles for future purposes, or into excrementitious matters.

The entire suspension of the formation of the gelatinous processes from the blood is probably incompatible with life; but the mal-formation and consequent imperfect development of gelatine seems to take place in a variety of degrees and modes. Circumstances also appear to show, that destructive mal-assimilation is equally, if not more frequent than the formative mal-assimilation of the gelatinous tissues; at least as far as regards the class of derangements we are now considering. It is probable, however, that in all instances, both formative and destructive mal-assimilation not only of the gelatinous, but of all the other tissues, takes place in a greater or less degree simultaneously. As illustrative of these remarks we may observe, that during the secondary formative assimilating processes, instead of gelatine, various unnatural compounds, as sugar, oxalic acid, &c., may be produced; which may not only interfere with the immediate functions of the organs affected, but with the functions of remote organs, as the kidneys, &c., destined to remove such unnatural matters. Again,

always, associated; and the gouty chalkstones of old age may be considered as little more than modifications of the scrofulous tubercle of youth, both being alike formed from mal-assimilation of the albuminous principle. Moreover, the offspring of those labouring under gout and struma are (other circumstances being favourable) more subject, during the period of adolescence, to tubercular phthisis, than other individuals. Large deposits of the gouty chalkstone, in middle or advanced age, are often accompanied by incipient disease of the kidneys. This subject has been briefly discussed under the head of *struma*. See page 240.

during the secondary destructive assimilation of the gelatinous tissues, not only the same unnatural matters, as well as others, derived from them, may be generated; but matters of a complementary nature, and of a still more injurious character, may be produced. For in complementary decomposition, it should be borne in mind, that when *one* unnatural product is generated, another unnatural complementary product *must* be generated likewise; so that a single error may give occasion to very complicated and formidable consequences.

Precisely similar remarks are applicable to secondary mal-assimilation of the albuminificating processes. The albuminous tissues during the secondary formative assimilating processes may be unnaturally developed; while during the secondary destructive assimilating processes, the albuminous tissues may be imperfectly reduced and converted; and in both instances, the complementary products formed must be unnatural likewise, and thus give occasion to various morbid derangements. As instances of the unnatural matters developed during the secondary mal-assimilation of the albuminous tissues; strumous matters, the gouty chalkstone, &c., may be mentioned as developed by formative mal-assimilation; while instead of the lithate of ammonia, which seems to be naturally developed during the destructive mal-assimilation of those tissues, various poisonous principles having relation to the lithic acid in their composition, such as the different compounds of cyanogen, &c., before alluded to, are in some instances undoubtedly generated, and prove the source of formidable secondary derangements, and even of death itself.

With respect to the mal-assimilation, formative and destructive, of the oleaginous tissues or rather principles, I shall barely remind the reader of what has been already stated, viz. that they appear to be of equal, if not of greater, importance to the animal economy, than even the mal-assimilation of the gelatinous and albuminous tissues.

It remains, in concluding this part of the subject, to take a brief view of the leading phenomena, for the purpose of pointing out the relations and relative importance, of primary and secondary mal-assimilation, as displayed in their effects on the animal economy.

Mal-assimilation, both primary and secondary, may be induced by a variety of external causes, or may be inherent. As an instance of induced affection, we may mention the mal-assimilation resulting from the cause, whatever it may be, of idiopathic fever—a cause so affecting the organic system, and the primary assimilating functions in particular, that for the time, these functions are sometimes entirely suspended or destroyed. On the other hand, the secondary assimilating functions, though perhaps imperfectly performed, nevertheless proceed; so that the body, supported in a great degree by the materials of its own substance, becomes emaciated. In fevers of the remittent character produced by malaria, the same phenomena to a certain extent take place; but, in addition, remarkable derangements of the secondary assimilating processes are apt to take place; and unnatural matters, more especially of an acid kind, are generated, which produce, or at least contribute to produce, in their turn, a variety of formidable secondary affections, as hepatic and kidney derangements; also rheumatism, neuralgic affections, &c.

Derangements of the assimilating organs may arise from errors in the quantity or quality of diet, and will vary accordingly. When too much food is taken relatively to the constitution of an individual, either the primary or secondary assimilating processes, or both, may more especially suffer. In some instances, the primary assimilating organs are so weak and so easily deranged, that individuals are constrained to be careful, both with respect to the quantity and quality of their food; and such individuals often escape the more serious and deeper-seated diseases of a secondary kind, arising from excess. On the other hand, there are individuals whose primary organs will permit them to take with impunity enormous quantities of all sorts of matters. In some of these instances, such matters pass off by the bowels very little assimilated; in others, a large portion of them undergo, more or less perfectly, the primary assimilating processes, and are carried into the mass of blood; and individuals to whom this takes place, suffer more especially from derangements of the secondary assimilating processes; as from hepatic congestion, gout, &c., particularly about the middle periods of life, when the consequences of excesses of all kinds begin to be manifested. With respect to errors in the quality of the diet, these are so

numerous and varied, that it is impossible to do more than notice them here, and to observe that many of the most severe and formidable diseases, both of a particular and of an epidemic character, may undoubtedly be traced to this cause. See the section on *Struma* already referred to.

Errors of the secondary assimilating processes, whether induced by long derangements of the primary, or whether they arise from original weakness, are manifested at different periods of life, and in different individuals, not only in the various modes mentioned, but in various other ways. As instances we may mention, that in early life the conjunction of secondary with primary mal-assimilation is 'most usually displayed in the various forms of strumous affection or atrophy,'* while in middle life the same combination of derangements more especially assumes the form of local congestions, hypertrophies,† gout, &c. Such is the case when the derangements are of a general character, and involve the formation of all the tissues of the body in a moderate

* Atrophy may arise from deficient or imperfect assimilation, either primary or secondary, or both; but in a great many instances it is connected with excessive action in the secondary destructive processes, by which the various tissues are removed from the body faster than they are produced. This derangement of the balance between the primary and secondary processes of assimilation, (which usually arises more from affections of the primary than of the secondary organs,) takes place in fevers and many other diseases, as stated in the text.

† Certain states of hypertrophy and of dropsy, particularly anasarca, appear to be nearly related, and to have their origin in the same cause, viz., deficient or deranged action of the destractive processes of secondary assimilation. Thus in hypertrophies, (by which I mean unnatural accumulations of natural solid matters,) the secondary formative processes go on uninterruptedly, while the secondary destructive processes are imperfectly performed, and accumulation is the necessary consequence; so in anasarca, the exhalent, (formative) process goes on as in health, while the absorbent (destructive) process is imperfectly performed, and accumulation, as before, takes place; but with this accidental difference, that the one is a *solid*, the other a *fluid*, accumulation. Such accumulations, particularly of fat and water, when of an unnatural character, are often connected with deranged action or organic disease of some of the *great outlets* by which imperfect or effete matters are removed from the system; or of the liver, kidneys, &c. On the other hand, unnatural accumulations of albuminous or gelatinous tissues are more frequently the result of some *local* imperfection in the destructive processes of secondary assimilation.

degree. When the mal-assimilation is chiefly confined to the gelatinous tissues, the derangements are more especially displayed in the form of certain cutaneous affections, destructive suppuration, or other disease, of the cellular tissues; likewise diabetes, oxalic acid affections, &c. When the development, &c., of the albuminous tissues is chiefly deranged, organic diseases of various kinds connected with these tissues, also lithic acid gravel, &c., are usually the result. Finally, when the mal-assimilation is excessive, and involves the oleaginous in conjunction with the other tissues, the consequence is usually some form of malignant or incurable organic disease.

Lastly, in further illustration of the present part of our subject, the reader may be reminded of what has already been incidentally stated,—that secondary diseases depending on primary mal-assimilation, are in general of a much less formidable character, than remote or secondary diseases depending on secondary mal-assimilation. Thus, the occasional appearance of sugar, oxalic acid, &c., in the urine, as the result of the introduction or development of these matters in the stomach, is of an infinitely less serious character, than the appearance of sugar, oxalic acid, &c., in the urine, as the result of the secondary mal-assimilation of the gelatinous tissues. In the first form of these urinary derangements, except when unusually severe, the derangements are confined to the stomach, &c., while the constitutional symptoms are generally trifling; on the other hand, when the sugar, oxalic acid, &c., are produced during the secondary assimilating processes, not only are the constitutional symptoms strongly marked, but there is frequently visible disorganisation of the gelatinous tissues, appearing in the form of carbuncles, cutaneous diseases, &c. Similar remarks may be made respecting the appearance in the urine of the lithate of ammonia, &c. The appearance of the lithate of ammonia in the urine, as everybody knows, is one of the most common attendants of slight dyspepsia from errors of diet, &c. But the lithate of ammonia appears in the urine also, when no food has been taken into the stomach, and, when, therefore, its formation can be only referred to secondary mal-assimilation of the albuminous contents of the blood, or albuminous tissues; as for instance, in certain fevers and other severe constitutional diseases. It would be easy to multiply instances of this

kind, but we shall merely observe in conclusion, that the practical utility of these views, by indicating the true principles of treatment, is often of first-rate importance.

For the sake of further illustration we shall briefly recapitulate what has been stated in the preceding pages under another point of view, viz., the relations of the saccharine, oleaginous, and albuminous principles to one another, and to vital action.

The saccharine principle in its simplest form, consisting of water to which carbon has been superadded, may be viewed as the intermediate link between inorganised and organised matter—as the first step as it were towards organisation. It is a question however whether any principle composed simply of water and carbon is capable of organisation, or at least *is* organised. The amyaceous principle or starch seems to offer the first organised step in the saccharine series, and this always contains, though in extremely minute quantity, certain other elements besides water and carbon, viz., azote, phosphorus, &c.; by the aid of which the simple saccharine compound apparently becomes organised and capable of constituting a part of a living organised being.

The lowest vital agency we are acquainted with,—the vital agency of plants, is capable of associating water with carbon, and forming the saccharine principle. This union between water and carbon *may* be in part direct, (I believe it *is* so,) but it seems to take place most usually by the aid of a collateral extrication of oxygen; *i. e.*, carbonic acid is decomposed, the oxygen, the great antagonist of vital action, by being placed in a false position (viz., a position in which its mechanical properties in a great measure annul its chemical properties) is set free in its *gaseous* state; while the nascent and unfettered carbon is appropriated. When this union between water and carbon is simple, sugar results: when the union is more complicated, and azote, phosphorus, &c. are involved; compounds in various intermediate grades between sugar and albumen are perhaps formed. In these processes the vital powers become more firmly established in proportion to the involution of azote, &c.; and consequently more capable of resisting the antagonising powers of oxygen; which may therefore be partly set free, as in the simple formation of sugar above mentioned; or in its turn be even appropriated.

Whether the vital energies of plants can convert oleaginous into saccharine and albuminous matters, has not I believe been ascertained ; but the vital organs, both of plants and animals can accomplish the reverse act, *i. e.* can *change the saccharine into oleaginous matters*, and this is probably the usual mode in which oleaginous matters are formed in plants and animals. Moreover, we have attempted to show that the vital energies of animals, as exerted during the secondary assimilating processes, can apparently change oleaginous matters into all the principles necessary to maintain animal existence.

The association of water first with carbon and afterwards with azote has been maintained to be peculiar to plants. It is undoubtedly *the peculiar function of plants* ; but it is not limited to them. In all animals there is a vegetative organ, (if we may be allowed the expression) capable in a greater or less degree of performing the same functions as vegetables, *i. e.* of combining water with carbon ; or if not beginning at this low point of the scale, at least of combining the organised saccharine principle with azote, &c., so as to form albuminous products. This vegetative organ is the *liver* ; and though the vegetative faculty alluded to appears to exist in the livers of different animals in very different degrees, yet in no instance is it entirely wanting. In all the more perfect, and particularly in carnivorous, animals, when appropriately fed, this function is little called into action ; and its existence therefore is probably intended merely as a resource to fall back upon in case of necessity. Without it, however, animal life would be most precarious, or in many instances even impossible.

Such are the grounds on which the fundamental doctrines of this volume principally rest, viz. ; that water, the basis of all organisation, is first combined with carbon to form the primary organised compound the *saccharine radical* ; that the saccharine radical by undergoing certain changes is converted on the one hand into the *oleaginous radical* ; and on the other, by undergoing certain changes and involving azote, is converted into the *albuminous radical or principle*. Consequently, that the *albuminous principle on account of its involving the inferior radicals, must in all its ulterior changes be more or less influenced by the presence of these radicals*.

SECTION *f.**Of the General Composition and Properties of the Blood.*

HAVING briefly described the phenomena of the primary and secondary assimilating processes, we have in the next place to consider their general result, as displayed in the form of the *blood*—that important fluid by means of which, all the ulterior processes of vitality are exerted, and from which the corporeal frame is fabricated.

The blood, as we have seen, is derived from two sources ; from the *chyle*, the result of the primary assimilating processes ; and from the *lymph*, the result of the secondary assimilating processes carried on all over the body. The chyle is conveyed by the *lacteals*, the lymph by the *lymphatics*, (two orders of the same class of vessels,) to the common thoracic duct, from whence their mixed contents are discharged into the general mass of blood. It would be foreign to our present purpose to enter here on a formal description either of the chyle or the lymph ; but we shall merely observe, that the lymph has usually been considered by physiologists as excrementitious, an opinion to which we cannot accede. That *some* of the materials of the lymph, as well as of the chyle, are excrementitious, we have no doubt. Very strong arguments, however, may be adduced in favour of the opinion expressed in the preceding sections, namely,—that many of the principles formed during the secondary assimilating processes carried on all over the body, and contained in the lymph, are designed for future purposes of a higher order in the animal economy, than the cruder principles conveyed by the chyle ; for which their more perfectly elaborated character may be supposed to fit them. Our limits, however, will not permit us to detail the arguments in favour of this opinion at present ; and we must refer the reader

who is interested in the matter, to what we have elsewhere said on the subject.*

Of the blood.—The chief constituent principles of the blood, as already observed, are of an albuminous nature. The albuminous matters exist principally in three forms, viz., in the form of *albumen*, properly so called, of *fibrin*, and of *hæmatosine*, or the red colouring principle of the blood. Besides these albuminous matters, the blood also contains minute quantities of oleaginous, saline, and other principles. The proportions of these ingredients are liable to variations; their general proportions are shown in the following table, which contains the results, and mean, of two analyses of the blood by M. Lecanu, one of the most recent and accurate writers on the subject.†

One thousand parts of blood contain	Expt. 1.	Expt. 2.	Mean of two results.
Water - - - -	780·145	785·590	782·87
Fibrin - - - -	2·100	3·565	2·83
Albumen - - - -	65·090	69·415	67·25
Colouring matter - - - -	133·000	119·626	126·31
Fatty matter { Crystalline - -	2·430	4·300	3·37
{ Oily - -	1·310	2·270	1·79
Extractive matter soluble in alcohol	1·790	1·920	1·86
Albuminate of soda - -	1·265	2·010	1·64
Muriate of soda - -			
Muriate of potash - -			
Carbonate } of soda - -	8·370	7·304	7·84
Phosphate } and - -			
Sulphate } potash - -			
Carbonate of lime - -			
Carbonate of magnesia - -			
Phosphate of lime - -	2·100	1·414	1·75
Phosphate of magnesia - -			
Phosphate of iron - -			
Loss - - - -	2·400	2·586	2·49
	1000·000	1000·000	1000·000

* Bridgewater Treatise, Book III. See also Müller's Physiology, p. 155, second edition, where an attempt is made to show that the organised globules found in the lymph are globules of the blood in an incipient state.

† Beiträge zur Anat. Zool. und Phisiol. Gött. 1831. I believe more recent analyses of the blood have been published: but I am not aware that they materially affect the results drawn by Lecanu from his laborious and valuable

The mean of the two results, given in the third column of the preceding table, probably represents nearly the average proportions of the different ingredients of the blood, in the healthy state. Of these different ingredients, it may be stated, that the red particles are held in suspension only, while all the other ingredients exist in solution in the watery portion of the blood;* and that several of the saline matters mentioned in the table do not naturally exist in the blood at all, but are the results of the analytic processes. The existence of these saline matters among the analytic results, may be thus explained.

It has been stated, that albumen contains minute quantities of sulphur, phosphorus, and other matters in incidental union with the hydrogen, carbon, oxygen, and azote, of which it is essentially composed; and besides these incidental ingredients, the *haematosine* or red colouring matter of the blood has also been found to contain iron.† Henee Berzelius thinks, with great probability, that the sulphates and phosphates obtained by incinerating the albuminous principles of the blood are formed by oxidation from the sulphur, phosphorus, calcium, magnesium, and iron, which he supposes to have originally existed in incidental union with the essential elements of the albuminous principles, as above stated. The specific gravity of human blood varies from about 1·053 to 1·057. The specific gravity of the serum of the blood, usually lies between 1·027 and 1·029. Hence the fibrin and the red particles must be considerably heavier than serum.

investigation of the blood. A few points of importance lately ascertained will be noticed as we proceed.

* I do not know whether the mode in which the fatty matter exists in the blood, has yet been satisfactorily ascertained. Most probably, on ordinary occasions, it is associated with some of the organised principles. When in great excess, it appears to be simply diffused through, and suspended in the blood, like oil in an emulsion.

† *Haematosine*, as stated in a preceding paragraph, was formerly considered (chiefly on the authority of Berzelius) as an albuminous principle. The recent experiments, however, of Lecanu, and particularly of Mulder, show that besides six or seven per cent. of iron, *haematosine* contains nearly twelve per cent. more of carbon than albumen.

For some most important remarks on the *structure* of the blood corpuscle, the reader is referred to a paper by Dr. G. S. Rees and S. Lane in the Guy's Hospital Reports, vi., 379.

The specific gravity of neither of these two ingredients of the blood is accurately known; but the specific gravity of the red particles is undoubtedly greater than that of the fibrin.

Mulder has attempted to show that a principle, which he has called *proteine*, constitutes the basis of all albuminous matters. Hence, according to this opinion, the differences between albumen, fibrin, caseine, gluten, &c., depend on the nature of the incidental matters present, and on the nature of their combination. This opinion, in certain points of view, is not improbable, though I do not consider it to be established.*

On looking over the preceding table, one of the most obvious facts that first strikes our attention, is the conspicuous place, among the constituent principles of the blood, occupied by two of the great alimentary principles formerly described, viz., the albuminous and the oleaginous principles; while the third, the saccharine principle, is entirely absent. Even the animal (saccharino) principle gelatine, though existing abundantly in various structures, is never found in the blood, nor in any product of glandular secretion. The only constituent of the blood we can suppose to immediately represent the saccharine alimentary principle, is, perhaps, the lactic acid, which Berzelius places among the constituent principles of the blood, and of most animal products soluble in alcohol. M. Lecanu, however, has not specified the lactic acid among the results of his analysis; although there can be little doubt that this acid, if not always present, is at least very rarely absent from the blood. The lactic acid *in the blood* may be either derived from the primary or from the secondary processes of assimilation. The lactic acid *secreted* from the blood may be partly derived from the saccharine and partly from the albuminous principles, which as already noticed, are supposed to contain, or remotely include, the saccharine radical.†

* Ann. der. Pharm. xxviii. 75, and xl. 43. Since this was written there has been a controversy on this subject between Liebig and Mulder, in which others have joined. Though I by no means approve of the spirit in which this controversy has been carried on, I have always thought Liebig, chemically speaking, in the right. There may be a fundamental radical analogous to the principle called *proteine* by Mulder, but it has not yet been discovered.

† See below; also page 498, and note, page 507.

With reference to the present subject, it remains to remind the reader of two points we have elsewhere attempted to illustrate, viz., 1st, *the formation of gelatine* during the conversion of the arterial into venous blood, and the relations of the carbon, supposed to be liberated during such conversion, to the respiratory process : and 2ndly, *the dimorphous relations of albumen and fibrin*; which we suppose to depend, in a certain degree, on the presence of different proportions of combined water in these two principles—a supposition which, taken in conjunction with a presumed self-repulsive action among the molecules of the living fibrin, may be so applied as to offer a plausible explanation of many of the phenomena presented by the blood ; and particularly of the phenomena connected with its spontaneous coagulation, &c.*.

Before we close, we shall briefly notice some conclusions lately published by Liebig, in his recent work entitled “Researches on the Chemistry of Food.” These conclusions, on the whole, are the most interesting advanced by the author ; and though they will probably require to be corrected or modified before they can be safely applied to the ulterior purposes of physiology, we regard them as the most important chemical step in a right direction, that has been lately made.

1. The blood and lymph which circulate through the body in general are *alkaline*, and abound in the phosphate of soda and common salt; on the other hand, in the juice of muscular flesh which is always *acid*, the phosphate of potash and muriate of potash preponderate. Lactic acid abounds in the juice of flesh ; but as fast as it enters the mass of blood is consumed by the process of respiration. Hence, as stated, this acid is not found in healthy blood nor in healthy urine.

2. The phosphate of soda in the blood having an *alkaline* reaction, absorbs the carbonic acid supposed to be formed during the conversion of arterial into venous blood, and gives it out in the lungs. The phosphate of potash, cannot be substituted for the phosphate of soda in the blood, for this purpose, on account of its tendency to an *acid* rather than an *alkaline* reaction.

* See Bridgewater Treatise.

3. The phosphate of potash when placed in contact with common salt, is decomposed, and the phosphate of soda results. From this decomposition the phosphate of soda in the blood is produced, when the food of animals contains only phosphate of potash and common salt.

4. The juice of flesh and the urine contain a peculiar principle *kreatine*, and a powerful base *kreatinine*, which are supposed to perform peculiar functions. Some have doubted whether these principles really exist in the juice of flesh, and have supposed that they are eliminated during the chemical operations made to obtain them. We confess that we participate in this doubt, from a knowledge of the peculiar action of the kidneys, which would be more likely to form kreatine and kreatinine from appropriate materials, than to permit them to pass through the ordeal of excretion without change. The exact functions of these new principles in the animal economy have not yet been ascertained. We shall briefly consider their properties when we come to speak of the urine.

Such is a summary of the principal circumstances brought forward by Liebig in his recent work. In their general character and drift as already stated, we regard them of first-rate importance.

The following table presents a comparative view of the composition of the different modifications of the albuminous principle according to recent experiments :

	Hydrogen.	Carbon.	Oxygen.	Azote.	Incidental and other matters.	Authority.
Albumen	7.09	54.84	21.23	15.83	0.33 P, 0.68 S	Mulder
Fibrin	6.90	54.56	22.13	15.72	0.33 P, 0.36 S	Do.
Caseine	7.15	54.96	21.73	15.80	0.36 S	Do.
Gelatine	6.48	50.05	25.12	18.35		Do.
Hæmatosine	5.30	66.49	11.01	10.54	6.66 F	Simon.

* P. phosphorus. S. sulphur. F. iron.

SECTION 9.

Of the Functions of the Liver, and the relation of the Bile to the assimilating processes. Of the composition of the Bile ; and biliary Concretions.

THE nature of this treatise precludes a detailed account of the anatomy and structure of the liver; yet we may remind the reader, that the venous blood from the assimilating viscera undergoes in this organ a preliminary arterialising process before it is remingled with the venous blood from the rest of the body. That is, the veins from the organs of digestion unite into one large vessel termed the *vena portæ*, which entering the liver is then again subdivided in the same manner as the artery. These ultimate subdivisions of the *vena portæ*, together with the similar subdivisions of the proper artery of the liver, coalesce; and from the blood thus mixed the bile is separated. The coalesced blood-vessels assuming the character of veins, then gradually unite, and at length, form two or three tubes, which empty themselves into the general veins going to the heart; while the hepatic ducts, uniting in like manner, convey the bile to the gall bladder. Such are the principal facts connected with the circulation of the blood in the abdominal viscera, and with the secretion of the bile.

We have shown in the preceding sections, that the conversion of the crude and *dead* alimentary matters into the *living* blood during the primary assimilating processes is accomplished by a succession of important changes, some of which are intelligible to us, while the nature of others is unknown. What we see and know, however, are quite sufficient to show us, that all these processes are conducted by, and at the expense of, the living animal body in which they take place; that is to say, not only the material but the *immaterial* agents required in the important processes carried on in the stomach, &c., originally reside in and are derived

from, the blood. It follows, therefore, that the blood which has thus been robbed of many of its materials, as well as of a portion of its *vitality*, becomes ill-adapted for the future operations of life, till it has undergone certain *dépuratory* processes in the hepatic system. Accordingly, we find, that by the peculiar arrangement above mentioned, the greater portion of the venous blood from the assimilating organs, before it is again mixed with the arterial blood, passes through the liver; where the unnatural and deteriorated matters, complementary to those which had been separated in the stomach, &c., are in their turn eliminated, in conjunction with other matters, as *bile*. In this point of view, the functions of the liver may be considered as *excretory* only; but that this important organ performs a positive as well as a negative or excreting function, there can be no doubt. In a former section, we alluded to one of these functions, viz., the obvious secondary function of neutralising the *acid* products of digestion; but this, though important, is perhaps subordinate to other secondary functions performed at the same time, of which we know but little; there is reason, however, to believe, that certain other biliary matters are absorbed with the chyle, and perform various offices, one of the most important of which seems to be more especially connected with the elimination of albumen from saccharine aliments;* while another appears to be connected with

* In a former section, we stated that large quantities of lactic acid are occasionally secreted from the blood into the stomach. Now if this lactic acid be chiefly derived from an albuminous principle, as is most probable; the principle, complementary to this lactic acid (left behind in the blood and supposed to be thrown out by the liver,) must contain an unusual proportion of azote; must, in short, be analogous in its composition to urea, &c. If this be admitted, we may suppose such highly azotised principle to combine again in the duodenum, with a portion of the saccharine aliments taken as food, and thus partially convert them into albumen. That in a perfectly healthy condition of the organs some such changes take place, I have at present no doubt whatever; for I have constantly found albumen developed in abundance in the duodenum of animals, whether the food contained azote or not. The atmospheric air involved during the mastication and salivation of their food, is very probably another source of azote to vegetable feeders. Indeed, this involution of azote may be considered as one of the great objects of mastication, &c., which is almost peculiar to animals chiefly subsisting on saccharine matters. See page 499, where this peculiar *vegetative* function attributed to the liver is further considered.

the development of the colouring principle of the blood. With this part of the subject, however, we have nothing to do at present. It is sufficient for our present purpose, to state that the bile, as *discharged by the liver*, consists of principles partaking of a twofold character; viz., of principles of an assimilated and secreted kind designed for ulterior purposes; and of products of an effete and excrementitious character, destined for expulsion from the economy.

With the exact composition and nature of the bile, as discharged from the liver during the digestive processes, we are but imperfectly acquainted; for the bile collected from the gall-bladder and other sources, for examination, has probably lost some of its important *positive* or active principles, and consists of little more than matters destined to be excreted. The composition, however, of this important fluid, even as we know it, when taken in conjunction with the phenomena detailed in the preceding sections, sufficiently bears us out in what we have above advanced; as the following statement will show.

Of the properties and composition of the bile.—The bile, as we are acquainted with it, is a yellow or greenish yellow fluid of a peculiar sickly odour, which has been compared to that of melted fat. Its taste is bitter, and at the same time sweetish, and excessively nauseous. Bile is heavier than water; the specific gravity of ox bile, for instance, varying from 1.026 to 1.030. Its consistence, like its specific gravity, is variable, being sometimes limpid, but more commonly viscid and ropy. It is generally understood to have a slight alkaline reaction; but the effects of bile on test papers are difficult to distinguish, on account of its colour.

The composition of bile has been variously stated by different chemists; but they all agree in the points more immediately connected with our present inquiry, viz. that relatively, the essential principle (or principles) of bile contains a very large proportion of carbon, and little of azote; and that there is also present a considerable proportion of soda in some very loose state of combination.

The following is a brief history of the different opinions that have been held on the composition of the bile.

The most celebrated of the older analyses of the bile are those

of Thenard, Berzelius, and Tiedemann and Gmelin. We shall first give Tiedemann and Gmelin's description and analysis;* and after briefly stating the results of Thenard† and Berzelius,‡ proceed to notice the more recent views of Demarçay.§

The number of ingredients in the bile, according to Tiedemann and Gmelin, is very great. Of these, several seem to be nearly allied in their properties, and are, probably, only modifications of the same substance. Others appear to be the results of the processes employed to separate them. The following is an enumeration of the different ingredients which, according to these chemists, exist in the bile of the ox:

One hundred parts of ox-bile contain a variable proportion of water: the specimen analysed contained 91.5 parts of water; the other 8.5 parts consisted of the following *animal* matters: *

Biliary resin; cholesterine; colouring matter; picromel; biliary asparagine; a highly azotised substance little soluble in water; an animal matter (gliadine?) insoluble in water; a substance giving off an urinous odour when burnt; an albuminous matter, mixed probably with some caseous matter; mucus.

And the following *saline* matters:

Bicarbonate of ammonia; margarate, oleate, acetate, cholate, bicarbonate, phosphate, and sulphate of soda, (with a little potash); muriate of soda; phosphate of lime.||

The proportions of these different ingredients were not ascertained, and they are probably variable. The biliary resin and the picromel are stated to be by far the most abundant.

Of the biliary resin, cholesterine, and colouring matters.—On the biliary resin seems to depend, in a great degree, the sensible properties of the bile; that is, its peculiar smell, its bitter taste,

* See Recherches expérimentales, physiologiques, et chimiques, sur la digestion. Par Fred. Tiedemann et Leop. Gmelin. Traduites de l'Allemand par A. J. L. Jourdan. A Paris, 1826. Vol. i. p. 42.

† Mem. d' Arcueil, vol. i. pp. 23 et 46.

‡ Med. Chirurg. Transactions, vol. iii.

§ Ann. de Chemie et de Phys. lxvii. 200.

|| Lecanu and Casasecu have lately stated that they have detected the stearic and oleic acids in human bile. Journal de Pharmacie, 12.

and perhaps some of its colour. When pure, according to Tiedemann and Gmelin, it has a pale brown colour, is transparent, brittle, and easily broken when cold. At a moderate heat it softens, and may be drawn out into threads. It fuses completely a little above the boiling point of water. If the heat be increased, it swells up and burns with a vivid flame, and yields much smoke, giving off an aromatic odour. When distilled in close vessels, it yields an empyreumatic oil, and a very acid fluid containing barely a trace of ammonia. The *cholesterine* (and *oleic* acids) may be separated from the healthy bile of man and of most animals, by the action of alcohol and ether, in which they are soluble. Cholesterine, when pure, is a white brittle solid of a crystalline lamellated structure and brilliant lustre, very much resembling spermaceti; but it is distinguished from spermaceti by requiring a higher temperature for its fusion, and by its not forming a soap with potash. The state in which cholesterine exists in the bile is not known; but in a perfectly healthy condition of the secretion, it probably exists in solution. Cholesterine forms the chief ingredient of biliary concretions; and is also said to be found in parts unconnected with the hepatic circulation, as in various abscesses, encysted tumours, &c. The *colouring matter* of the bile differs somewhat in different animals, but it always possesses more or less of a yellow or brownish (orange-tawny) tint. It is insoluble in water and alcohol, but is readily dissolved by a solution of potash. The solution is at first of a yellowish brown colour, but gradually acquires a green tint, and the colouring matter is precipitated in green flocks by muriatic acid. According to the observations of Tiedemann and Gmelin, the colouring matter is influenced by the presence of oxygen. The yellowish precipitate occasioned by adding muriatic acid to bile, absorbs oxygen by exposure to air, and its colour changes to green. The action of nitric acid is still more remarkable. By successive additions of this acid, the tint of the colouring matter may be converted into green, blue, violet, and red, in the course of a few seconds. The yellow concretions found in the gall-bladder of the ox, and so much prized by painters for the beauty of their tint, are said to be composed almost entirely of the colouring matter of the bile.

These three principles, viz. the resin of the bile, the choles-

terine, and the colouring matter, seem in some degree to be allied to each other ; at least, there is reason to believe that their ultimate composition is so far alike, that they contain an excess of carbon relatively to their other ingredients. The colouring matter of bile contains azote which is not found in cholesterine, and but sparingly if at all in the biliary resin.*

Picromel.—This name was first given by Thenard to a substance he separated from bile ; the taste of which, as the name expresses, seems to be a compound of bitter and sweet. Tiedemann and Gmelin have shown, that the bitter part of the flavour is derived from a portion of adhering biliary resin, which Thenard had not separated ; and that when quite pure, the taste of picromel is sweet, without any bitterness. Picromel, when pure, occurs in opaque, rounded, crystalline particles, and is soluble both in water and in alcohol. It contains azote ; and from this and other circumstances, it seems to resemble the saccharine principle formed from gelatine by sulphuric acid, rather than common sugar. Picromel combines with the biliary principle, and the compound is soluble in water. It is found in considerable quantity in the bile of the ox ; and has more recently been detected in human bile, as well as in the bile of other animals.

Biliary asparagine, or *Taurin*, was found by Tiedemann and Gmelin in the bile of the ox ; but I believe it has not been found in the bile of any other animal. This principle has been recently found to contain a large proportion of sulphur.†

The remaining organised substances exist in bile in very small quantity, and are too ill-defined to enable us to form any definite notion of their properties ; that is to say, whether they are necessary or accidental ingredients in its composition. They probably depend on, or at least are liable to be much modified by, the food

* The following is the composition of the colouring matter of bile according to Scherer. One hundred parts contain 6·704 hydrogen, 67·409 carbon, 18·185 oxygen, and 6·704 azote. I analysed cholesterine a great many years ago, and found it to contain upwards of 80 per cent. carbon. According to Chevreul its exact composition is 11·880 hydrogen, 85·095 carbon, and 3·025 oxygen. Dried human bile as a whole, according to Dr. Kemp, contains about 69 per cent of carbon. Letter to Liebig, p. 37.

† According to Redtenbacher, one hundred parts of Taurin contain 11·25 hydrogen, 19·28 carbon, 38·04 oxygen, 5·73 azote, and 25·70 sulphur.

of the animal. They are said to contain azote; and one of them seems to be nearly allied to the ill-defined principle formerly termed *osmazome*, found in all animal fluids; on this we shall presently make a few remarks.

Mucus is a constant ingredient in bile in a greater or less degree, and is derived from the mucous membrane of the gall-bladder, &c.

Of the salts of the bile.—These may be classed under the heads of organised and inorganised. The organised, consisting of acids of animal origin, chiefly united to soda, are the margarate, olcate, cholate, and lactate? of soda; of these, the first three acids are probably intimately connected with the cholesterine and resinous principles of the bile. The other salts are of mineral origin, and are such as are usually found in all excreted fluids. They will be considered more minutely when we speak of the urine. The phosphate of lime was obtained by incinerating the bile.

Berzelius takes a totally different view of the composition of the bile from that above given. He denies that bile contains any resinous principle, and regards the resin, yellow matter, and pi-cromel, of Thenard, as constituting one substance, to which he applies the name of biliary matter.* This biliary matter is, according to him precipitable by acids. When sulphuric acid is used, and heat applied, a green matter is obtained, consisting of a compound of biliary matter and sulphuric acid, and which somewhat resembles resin. The acid may be separated by the carbonate of barytes, and the biliary matter thus obtained becomes soluble in water, to which it imparts its own colour and bitterness. The biliary matter, according to Berzelius, contains no azote. He states that one hundred parts of bile contain,

Water	.	.	.	.	.	.	90·74
Biliary matter	.	.	.	.	.	.	8·00
Mucus of the gall-bladder	.	.	.	.	.	.	·30
Alkalies and salts common to all animal fluids	.	.	.	.	.	.	·96
<hr/>							
							100·00

* Med. Chirurg. Trans. vol. iii.

A different and still more simple view of the constitution of bile has been lately advanced by M. Demarçay.* Indeed, this chemist seems to have gone far towards establishing the original idea of Cachet, viz. that bile may be considered as a kind of *soup*. Demarçay has attempted to show that the essential constituents of bile are soda and an oily acid, to which he has given the name of *choleic*. His directions for obtaining the choleic acid are the following :

Evaporate ox bile to dryness over a steam-bath, and digest the dry residue in alcohol. The choleate of soda will be dissolved, while the mucus, &c., are left behind. Distil off the alcohol by a steam-bath, and dissolve the residue in water. To the aqueous solution add as much sulphuric acid as will exactly neutralise all the soda in the solution ; digest for two days in a moderate heat, agitating frequently.† Then evaporate to dryness over a water-bath, and again digest the residue in alcohol. The choleic acid is dissolved, while sulphate of soda remains behind. Finally, distil off the alcohol, substitute water, and evaporate to dryness over the water-bath.

Choleic acid thus obtained is a spongy, pulverulent matter, which rapidly absorbs moisture from the atmosphere. Its taste is very bitter, with an impression of sweetness. Its powder irritates the nostrils and throat. It is insoluble in ether; but very soluble in alcohol, and moderately soluble in water.

The choleic acid is supposed to include all the organic constituents of the bile. When boiled for some time with an excess of muriatic acid, the choleic acid is converted into a new acid, the *choloidic* acid, which contains all the carbon and hydrogen of the bile, except those portions which have been separated in the form of *taurin* (Biliary asparagine of Tiedemann and Gmelin) and ammonia. When boiled with a fixed alkali, the choleic acid is converted into a still different acid, termed the *cholic* acid, (altogether different from the acid so named by Tiedemann and Gmelin,) which consists of the elements of choleic acid, minus those of carbonate of ammonia.

According to this view, bile is a compound of choleic acid and

* Ann. de Chemie et de Phys. lxvii. 177. 1838.

† The choleic acid may be also united with the oxide of lead by the action of the sub-acetate of lead, aided by ammonia.

soda ; yet it cannot be considered by any means as a *choleate of soda*, which, unlike bile, is decomposed by the weakest acids ; still with Liebig, I cannot help thinking that the views of Demarçay in general are correct, though it must be admitted that at present they are imperfect.*

A strong argument in favour of this opinion of the *unity* of bile is, the analogy it offers with lithic acid to be presently considered. The lithic acid, like bile, includes compounds having reference to different radicals. And if we consider the lithate of ammonia and other organised principles existing in healthy urine to constitute an unity or *entire* principle, like the choleate of soda, or *entire* bile, which is probable ; the analogy between bile and lithic acid will be still more striking.

The general results of all the analyses of the bile, then, as already stated, are—that the chief organic ingredients, in their properties and composition, partake of the oily character ; and—that the saline contents of bile consist principally of soda, which exists in some unknown state of combination with the biliary ingredients. The other saline ingredients are those found in all organic compounds.†

Of Biliary Concretions.

In particular states of the system connected with derangements of the assimilating processes, and more especially affecting the assimilation of the oleaginous principle, certain of the biliary ingredients are either formed in excess, or in some unnatural and detached condition ; so that they concrete together into masses which often prove a secondary source of excruciating suffering under the

* See Liebig's Animal Chemistry, page 315, et passim.

† For some criticisms by Berzelius on these conclusions of Demarçay and Liebig, see Rapport Annuel sur les Progrès de la Chemie, 1845, pp. 337, 382. Also Ranking's Abstract of the Medical Sciences, vol. i. p. 338, et seq. where some remarks by Platzer are also given.

name of *gall-stones*. The following remarks comprise a brief description of the principal forms, and composition, of such biliary concretions.

The most frequent form of biliary concretions, consists of cholesterine in different states of purity.* Concretions consisting of cholesterine, unless containing an unusually large proportion of colouring matters, &c., are commonly of a yellowish white or greenish colour; have a greasy, saponaceous feel, and swim on water.† When broken, they usually present more or less of a crystallised, shining, and lamellated structure; and, on exposure to a candle, readily melt and burn with a brilliant flame. Biliary concretions composed essentially of cholesterine vary from the size of a mustard seed, or even less, to that of an egg; and they generally contain an obvious nucleus of inspissated bile or some other matters. The larger specimens usually occupy the gall-bladder alone; while in other cases, instead of being collected into one or two masses, the cholesterine arranges itself around innumerable centres, and forms polygonal concretions of all sizes and shapes; and the latter, perhaps, is the most frequent occurrence.

Gall-stones consisting of inspissated bile, &c., are generally of

* Some of the properties of cholesterine and the colouring matter of bile have been already stated, and we may here further observe, that cholesterine may be distinguished from spermaceti and most of the other oleaginous products resembling it, by its high fusing point, which is 278° ; and by its not being converted into soap by caustic potash. It is free from taste and odour, and insoluble in water; but dissolves readily in boiling alcohol, from which it is deposited on cooling, in white pearly crystalline scales. The yellow colouring matter of bile is insoluble in alcohol, sparingly soluble in water, but readily soluble by digestion in a dilute solution of potash. Hence these two most frequently associated principles, cholesterine and colouring matter, may be separated, either by alcohol, which dissolves the cholesterine and leaves the colouring matter; or *vice versa*, by a solution of potash, which dissolves the colouring matter, and leaves the cholesterine.

The other forms of biliary concretions may be distinguished in general by the properties stated. It may be remarked, however, that they are seldom entirely free from the colouring matter of the bile, or even from cholesterine; and from these circumstances their biliary origin, in general, can be readily identified and established.

† Cholesterine, however, when quite pure has been recently shown to be heavier than water.

a dark colour, irregular shape, and free from all crystallised appearance. They are also heavier than water ; do not melt, and are not readily combustible ; and when burnt, sometimes leave a considerable quantity of carbonate and phosphate of lime. This species of biliary concretion appears to be subject to considerable variety in different instances.

Biliary concretions composed almost entirely of the colouring matter of the bile are exceedingly rare in the human subject. I have seen three specimens, for the first of which I was indebted to Mr. Hutchins. The other two have occurred in my own practice.* The concretions occasionally found in the gall-bladder of the ox are composed almost entirely of biliary colouring matter, and have, as before stated, been long in use among artists as a pigment.

Lastly, Mr. Taylor has recently described an unique concretion, supposed to be biliary, which he found in the collection of the Royal College of Surgeons, consisting essentially of the *stearate of lime*. This concretion "was externally of a dirty white colour, and had the greasy feel of cholesterine calculi ; it floated in water, and when applied to the tongue left an impression of bitterness. It was of an oval figure, slightly flattened, one inch and a half in length, rather better than an inch in thickness, and about an inch and a quarter in breadth ; but, being broken in this direction, its exact measurement could not be ascertained. It readily yielded to the knife, and the cut surface presented a polished appearance. Its structure was lamellar ; being composed of white and reddish yellow layers, arranged concentrically, and alternating with each other. The layers were easily separated. At its centre there was a small vacuity. When heated before the blowpipe, it readily fused, then caught fire, burning with a clear flame, and giving out the smell of animal matter, but nothing of a urinous character." For the details of the analysis we must refer to Mr. Taylor's paper.†

* See page 275.

† London and Edinburgh Philosophical Magazine, 1840.

SECTION h.

Of the Functions of the Kidneys; and of the relation of the Urine to the Assimilating Processes. Of the Composition of the Urine; and of Urinary Calculi.

THE urine like all the other products formed from the blood, except the bile, is separated from arterial blood. The renal or emulgent arteries are given off from the aorta in its descent through the abdominal region, and after comparatively a very short course, enter the kidneys. In the kidneys, the arteries become abruptly divided, and from their minute ramifications on the ultimate glandular structure of the kidneys, the urine is separated from the blood.* The depurated blood returns to the system as *venous* blood, by the emulgent veins; while the urine separated in different parts of the kidney is brought together by an appropriate structure very beautifully adapted for the purpose, into the common cavity or pelvis of the kidney. From the kidney the urine passes to the bladder, and after a greater or less delay in

* This was the old opinion; but Mr. Bowman has recently published an elaborate paper "On the Structure and Use of the Malpighian Bodies of the Kidney," (Philos. Trans. 1842; also an abstract in the Med. Gazette, vol. xxx. p. 831,) in which he has attempted to show, that, like the bile, *the urine is separated from venous blood*. His chief conclusions are the following: "1. That the epithelium lining the tubes is the proper organ, that secretes the characteristic products of the urine from the blood; and that it does this by first assimilating them into its own substance, and afterwards giving them up on its free surface. 2. That these proper urinous products require for their solution a large quantity of water. 3. That this water is furnished by the Malpighian tufts of capillaries, placed at the extremity of the uriniferous tubes. 4. That a further use of the Malpighian bodies seems to be that of sharing in regulating the amount of water in the body." See further remarks, p. 185. *et seq.*

this receptacle is discharged from the system, without being applied to any secondary purpose, like the bile. The circumstances thus connected with the separation of the urine from the blood have given occasion to the opinion that the urine is to be viewed as an *excretion*; that is, as a noxious fluid, the removal of which from the system is necessary to the due performance of the animal functions; nor does the accuracy of this opinion seem to admit of doubt.

Though for the reasons already stated, a formal description of the anatomical structure of the kidneys would be misplaced here; yet the following results of an extensive examination by M. Rayer, of the varieties in the *weight* and *size* of the organs in the two sexes, and at different ages, &c., are not only interesting, but important as regards some of the subjects discussed in the preceding pages.

1. That the kidneys of individuals of the same age are never exactly of the same weight,

2. That immediately after birth, the development of the kidneys, though progressive, offers such differences, that in one case the weight of a kidney of an infant of seventeen days old, may be strikingly less than the kidney of another infant of two days old.

3. That in infancy, adult age, and in manhood, the same differences in the weight of the kidney at the same age, are equally observable; so that the determination of atrophy or hypertrophy of the kidneys is not possible, unless the difference in the weight of the kidneys be very remarkable.

4. That the weight of the kidneys in women, particularly in old age, is less than in men.

5. That the left kidney generally weighs more than the right, at all ages.

6. That in old age the kidneys are generally as heavy as in the prime of life.

7. That when the kidney of an adult or old man, without any remarkable alteration of structure, varies much from three ounces, (*French weight*,) it ought to be regarded as having a morbid or an anomalous tendency; that is, a tendency to atrophy or hypertrophy, congenital or accidental.

The *size* of the kidneys is not always proportional to their weight; but generally speaking, the kidneys attain their largest

size in adult age. As age advances, they usually become less in bulk, but, firmer in consistence; so that, as above mentioned, the weight of the kidneys, at this age, does not diminish in proportion to their bulk.

M. Rayer has found the size of the kidney to vary in males, between eighteen and forty-five years of age, from three inches ten lines long, one inch one line wide, and one inch one line in thickness; to four inches ten lines long, two inches six lines wide, and one inch and nine lines in thickness, (*French measure.*) On the contrary, in males between fifty-five and eighty years of age, the variations have been between three inches six lines long, one inch six lines wide, and one inch thick; and four inches two lines long, two inches four lines wide, and one inch and five lines thick. In females, the variations have been less remarkable.*

Meckel supposed the weight of the kidney in an adult male to lie between three and four ounces; and its size to be about four inches long, two inches wide, and one inch thick at its internal, and somewhat less than an inch in its external part.†

The few remarks we have to offer on the functions of the kidneys, and the relations of the urinary secretion to the assimilating processes, will more naturally fall to be considered, after we have briefly described the sensible and chemical properties of that secretion.

Description and composition of the Urine.—Healthy human urine, when recently voided and still warm, is a transparent fluid of a light amber colour. At this time, it reddens litmus paper; and its odour is slightly aromatic, and somewhat resembles that of violets; but the taste is bitter and disagreeable. As it cools, the aromatic odour disappears, and gradually gives place to another which is peculiar, and well known by the name of *urinous*. In a few days the urinous odour is succeeded by another, which has been compared to sour milk. At length, this also gives way, and is finally succeeded by a fetid alkaline odour. The sensible qualities of the urine, however, as well as the changes it undergoes, are subject, as we have seen, to great variety from many causes; such as different articles of food, different diseases, &c.

* M. Rayer, *Traité des Maladies des Reins*, vol. i. page 5, et seq.

† Meckel, J. F., *Manuel d'Anatomie, Général et Descriptive*, vol. iii. page 553. Paris, 1825.

The standard *quantity* of urine voided by a healthy individual in a given time, has been variously estimated. Generally speaking, more urine is passed in winter and in cold climates, than in summer and in warm climates. Besides mere change of temperature, however, the quantity is liable to be influenced by many other circumstances; so that it is perhaps impossible to fix a standard *universally applicable*; and every individual must, to a certain extent, be measured by his own standard. Haller supposed the quantity voided in twenty-four hours to be as high as 49 ounces. Dr. Bostock thinks the estimate of Rye more correct, who fixed the standard quantity of 40 ounces. In the second edition of this work, I assumed 32 ounces as a fair average, taking the whole year together. If we allow a little more latitude, and suppose that the quantity varies in this country from 30 ounces in the summer to 40 ounces in the winter, we shall be probably very near the truth, as regards a person in good health, and who does not drink more than the simple wants of nature require.

Like the quantity of urine, the *specific gravity*, also, is liable to great variety, and has in consequence been variously estimated. In the earlier editions of this work, the specific gravity of healthy urine was stated to be between 1·010 and 1·015. This estimate has been considered too low, and it is undoubtedly lower than the specific gravity in many instances; particularly in the over-fed and dyspeptic inhabitants of large towns. The late Dr. James Crawford Gregory found the mean specific gravity of the urine in fifty apparently healthy individuals in Edinburgh, during the months of September, October, and November, at two o'clock in the day, to be 1022·46.* This is probably a little too high; and, after long and repeated attention to the subject, I am of opinion that the standard specific gravity of a healthy person in the prime of life, during the whole year in this country, scarcely reaches 1·020. If therefore, we estimate the average specific gravity to range from 1·015 in the winter to 1·025 in the summer, we shall be probably very near the truth as regards the generality of well-fed individuals, who are ordinarily reputed to be in good health.

* Edinburgh Medical Journal, Nos. 109 and 110.

The urine is one of the most heterogeneous fluids known ; as the following elaborate analysis made by Berzelius more than thirty years ago will show.* According to this eminent chemist —one thousand parts of healthy urine consist of

Quantity of urine :	.	.	.	.	.	.	.	1000.00
Specific gravity :	.	.	.	.	.	.	.
General Composition { Water	.	.	.	.	.	.	.	983.00
{ Solid matters	.	.	.	.	.	.	.	17.00
Water .	.	.	.	.	.	.	.	983.00
Urea .	.	.	.	.	.	.	.	30.10
Lithic acid .	.	.	.	.	.	.	.	1.00
Organic matters { Inseparable from each other	Lactic acid .	Lactate ammonia .	.	.	.	.	17.14 }	
Mucus of the bladder .	Colouring matters, &c.	.	.	.	.	.	.	17.46
Alkaline and Earthly Salts.	Sulphate potash .	Soda .	.	.	.	0.32 }	0.32	
	Phosphate soda .	Soda .	.	.	.	3.71	3.71	
	Muriate soda .	Amonia .	.	.	.	3.16	3.16	
Silic .	Phosphates, lime, and magnesia; trace fluate lime .	.	.	.	.	2.94	2.94	
			.	.	.	1.65	1.65	
			.	.	.	4.45	4.45	
			.	.	.	1.50	1.50	
			.	.	.	1.00	1.00	
			.	.	.	0.3	0.3	
								1000.00

The most recent and complete examinations of the urine are those of MM. Lecanu† and A. Becquerel.‡ The following table contains a summary of M. Becquerel's results, which we shall give in the first place, and afterwards compare with the results of Berzelius, M. Lecanu, and others. Since the last edition of this work was published, three additional principles—the hippuric acid, kreatine and kreatinine, have been added to the ingredients of healthy urine by Liebig. These and perhaps several other matters were formerly confounded together under the general name of *osmazome*.

* Med. Chirurg. Trans. vol. iii. The arrangement of the table has been somewhat altered, to render it the more easily comparable with M. Becquerel's table on the next page.

† Journal de Pharmacie, xxv. 681, et seq.

‡ Semeiotique des Urines. Paris, 1841.

TABLE.*

Representing in English weights and measures the mean normal Quantity, Specific Gravity, and Composition of the Urine in the different Sexes, as deduced from eight analyses, (four in each sex,) by M. Alfred Becquerel. *Semeiotique des Urines*, p. 7.

Quantity, Specific Gravity, and Composition of the Urine.	Male.		Female.		General Mean.	
	Urine in 24 hours.	Composition of 1000 parts.	Urine in 24 hours.	Composition of 1000 parts.	Urine in 24 hours.	Composition of 1000 parts.
Quantity of urine	44 fl. oz.	1000·000	48 fl. oz.	1000·000	46 fl. oz.	1000·000
Specific gravity of urine	1018·9		1015·12		1017·01	
General composition { Water	18949·6	908·815	20642·8	975·052	19796·2	971·035
{ Solid matters	609·9	31·183	528·0	24·948	568·9	28·066
Details of analysis.						
Water	18949·6	908·815	20642·8	975·052	19796·2	971·035
Urea	270·7	13·338	240·4	10·367	255·5	12·102
Lithic acid	7·6	0·391	8·6	0·406	8·1	0·398
Organic matters inseparable from each other. { Lactic acid	181·1	9·261	149·0	8·033	165·0	8·047
{ Lactato ammonia						
{ Colouring matters						
{ Extractive matters						
{ Muricate ammonia						
Fixed Salts indecomposable at a red heat. { Chlorides	150·5	7·695	130·0	6·143	a 140·3	b 6·918
{ Phosphates						
{ Sulphates						
{ Lime						
{ Soda						
{ Potash						
{ Magnesia						
	19559·5	1000·000	21170·8	1000·900	20365·1	1000·000

Composition of the entire quantity of fixed salts voided in 24 hours : and in 1000 parts of urine.

a Fixed Salts voided in 24 hours.

Chlorine	10·17
Sulphuric acid	17·33
Phosphoric acid	6·44
Potash	20·36
Soda }	79·97
Lime }	
Magnesia }	
	140·27

b Fixed Salts in 1000 parts

Chlorine	·502
Sulphuric acid	·855
Phosphoric acid	·317
Potash	1·300
Soda }	
Lime }	
Magnesia }	
	3·944
	6·918

*Quantity, Specific Gravity, and General Composition of the Urine.—*We do not know the kind or specific gravity of the

* 15·434 grs. Troy = 1 gramme; 437·5 grs. Troy = 1 fl. oz.: I have omitted the fractions of the fl. oz. as of no importance to the general statement.

urine analysed by Berzelius. In these respects, therefore, his results are not comparable with those of M. Becquerel. He informs us, indeed, that the specimen *became turbid on cooling*; and from this we may fairly infer that the specific gravity and quantity of solid ingredients present surpassed the average—an inference fully established by the analyses of MM. Lecanu and Becquerel.

The urine may be practically considered as of two kinds; the *urine of the morning (urina sanguinis)* and the *urine of the evening (urina chyli, or of assimilation ;)* and other things being equal, the specific gravity of the urine of assimilation, or that voided in the evening, after dinner, considerably exceeds the specific gravity of the *urina sanguinis*, or of that voided on first rising in the morning. To obviate this and similar anomalies, M. Becquerel collected the whole quantity of the urine voided in twenty-four hours; and it should be borne in mind that the specific gravities and quantities stated by him have always reference to this admixture of the whole quantity of urine voided in the period mentioned.

The following table shows the quantity of *dry* ingredients contained in 1000 parts of average or mixed urine, at the different specific gravities mentioned. This table which was constructed, as far as sp. gr. 1032, by M. Becquerel, has been recently extended by Dr. Golding Bird to sp. gr. 1046;* and finally by myself to 1056.

* The calculation and extension are very simple. M. Becquerel ascertained, by careful experiments, that the quantity of dry solid matters in 1000 parts corresponding to each degree of the hydrometer was equal to 1·65 parts. Hence we have only to multiply this number by the number of the degrees required, and we obtain the quantity of solid matters corresponding to this degree; the complement to which of course represents the quantity of water. It may be observed that the quantities here given are supposed to represent the solid matters in an *absolutely dry state*. Hence they differ from those formerly given, (page 26,) which were obtained by evaporating diabetic urine on a water bath till it ceased to lose weight. In this state the residue still contains water, which cannot be entirely separated without destroying the sugar, &c. The numbers formerly given, therefore, may perhaps be still considered as the most applicable to diabetic cases. *Semeiotique des Urines*, p. 17. *Medical Gazette*, xxxi. p. 681.

On comparing the results of Berzelius with those of M. Becquerel, a striking difference will be observed. According to M. Becquerel, 1000 parts of urine of the standard mean specific gravity of 1017·31, contain 28·066 parts of solid matters; whereas, according to Berzelius, 1000 parts of the urine he examined contained no less than *sixty-seven* parts — a quantity, according to M. Becquerel's table, corresponding to urine of specific gravity 1041. Now as 1041 is universally admitted to far exceed the standard specific gravity of healthy urine, making every allowance for difference of exsiccation, &c., we cannot help suspecting that error exists somewhere; in other words, we are driven to the conclusion, that though Berzelius' table may be supposed to represent pretty nearly the *relative* proportions of the different ingredients in the urine to one another, yet that it is not to be depended on in other respects.

On the other hand, from the apparent care with which M. Becquerel's experiments were made and repeated; as well as from their general coincidence with other recent observations, including my own, I have no hesitation in admitting their general accuracy. His tables, therefore, when corrected as below, may be probably considered

The application of this table is easy. The imperial pint contains 8750 grs. of distilled water at the temperature of 62°. Suppose two pints of urine of sp. gr. 1020 passed in twenty-four hours, one thousand grains of this urine will contain by the table 33 grs. of solid matters. Hence 17500 grs., or two pints, will contain 577·5 grs., which is the quantity of solid matters passed in the time mentioned.

Sp. gr.	Water in 1000 parts.	Solids in 1000 parts.
1000	1000	0·0
1001	998·35	1·65
1002	996·7	3·3
1004	993·4	6·6
1006	990·1	9·9
1008	986·8	13·2
1010	983·5	16·5
1012	980·2	19·8
1014	976·9	23·1
1016	973·6	26·4
1018	970·3	29·7
1020	967·0	33·0
1022	963·7	36·3
1024	960·4	39·6
1026	957·1	42·9
1028	953·8	46·2
1030	950·5	49·5
1032	947·2	52·8
1034	943·9	56·1
1036	940·6	59·4
1038	937·3	62·7
1040	934·0	66·0
1042	930·7	69·3
1044	927·4	72·6
1046	924·1	75·9
1048	920·8	79·2
1050	917·5	82·5
1052	914·2	85·8
1054	910·9	89·1
1056	907·6	92·4

as presenting approximate results sufficiently near for practical purposes.

TABLE

Of the average Normal Quantity, Specific Gravity, and Composition of the Urine in this Country, as deduced from M. Becquerel's data.

Quantity, Specific Gravity, and Composition of the Urine.						Urine in 24 hours.	Composition of 1000 parts.
Quantity of urine	:	:	:	:	:	26 fl. oz.	1000
Specific gravity	:	:	:	:	:	1.020	
General composition	Water	:	:	:	:	14807 grs.	967
	Solid matters	:	:	:	:	505	33
Details of Analysis.							
Water	:	:	:	:	:	14807 grs.	967
Urea	:	:	:	:	:	226.892	14.230
Lithic acid	:	:	:	:	:	7.190	.460
Organic matters inseparable from each other.	Lactic acid	:	:	:	:		
	Laetate ammonia	:	:	:	:		
	Colouring matters	:	:	:	:		
	Extractive matters	:	:	:	:		
	Muriate ammonia	:	:	:	:		
Fixed Salts inde- composable at a red heat.	Chlorides	Lime				140.467	10.167
	Phosphates	Soda					
	Sulphates	Potash					
		Magnesia					
						a 124.541	b 8.135
						15312.000	1000.000

Composition of the entire quantity of Fixed Salts voided in 24 hours; and in 1000 parts of Urine.

a Fixed Salts voided in 24 hours.

Chlorine	:	9.04
Sulphuric acid	:	15.39
Phosphoric acid	:	5.72
Potash	:	23.40
Soda	:	
Lime	{	70.99
Magnesia	}	

124.54

b Fixed Salts in 1000 parts.

Chlorine	:	.591
Sulphuric acid	:	1.006
Phosphoric acid	:	.373
Potash	:	1.529
Soda	{	
Lime	{	
Magnesia	}	

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The corrections alluded to in the preceding paragraph relate to the mean quantity and specific gravity of the urine passed in twenty-four hours, and scarcely affect the *relations* among the ingredients. M. Becquerel estimates the mean quantity and specific gravity of the urine passed in twenty-four hours at about 46 oz. of specific gravity 1017.01. Now these estimates, though I have

little doubt of their accuracy with respect to France, are certainly inapplicable to this country, and the estimates given in a preceding page, (viz. forty ounces of sp. gr. 1·015 in the winter, to thirty ounces of sp. gr. 1·025 in the summer,) are nearer to the truth. If, therefore, we take 35 oz. of specific gravity 1·020 (the means of these numbers) as our standard, and employ M. Becquerel's data as the basis of our calculations, we obtain the average healthy quantity, density, and composition of the urine applicable to this country, as given in the preceding table.*

We shall now take a brief survey of the constituents of healthy urine; and, after pointing out the leading qualities, proceed to show the most remarkable variations in quantity, to which the different ingredients are liable.

Of the general relation of water and of the solid constituents of the urine. Water, as we have stated, forms the base of the blood and urine, as well as of all animal fluids. When the quantity, however, is raised above or depressed below a certain standard, water becomes a source of disease; especially in the urine. Thus there is sometimes a simple increase of the watery portion of the urine, while the other principles remain the same, or become much diminished; as in hysteria, and in various nervous affections. Sometimes, the increased flow of urine is accompanied by an increased proportion of a natural ingredient, as of urea; or of unnatural ingredients, as of albumen or sugar. On the other hand, the proportion of water in the urine is not unfrequently very much diminished below the natural standard, as in the various forms of urinary suppression. Sometimes, when the cause of this suppression is mechanical, the urine is simply diminished in quantity, whilst its composition and other qualities remain the same; at other times, the suppression is connected with deranged action of the kidneys; and in these cases, while the proportion of water is diminished, the proportions of the other ingredients are relatively increased, as happens in various forms of gravel and calculus.

In a perfectly healthy condition of the system, the quantity and specific gravity of the urine may be considered as compensating

* I am happy to see that the statements here made have been approved of in general by Dr. Golding Bird. See Medical Gazette, vol. xxxi, p. 681.

each other. That is, any diminution or increase in the quantity of urine, arising from change of temperature, &c., is in health compensated for by its higher or lower specific gravity; so that the quantity of solid matters secreted from the system in a given time is always nearly the same. If, therefore, we know the quantity and specific gravity of the urine in instances similar to those mentioned in the preceding paragraph, we can form a tolerable estimate of the kind, as well as of the degree, of the derangement. In general when the quantity of urine and its specific gravity are both at the same time far below the healthy standard, the proportion of solid matters excreted from the system must be small likewise; and whether the deficiency arises from imperfect assimilation, or from local disease of the kidneys, such deficiency, when considerable, is incompatible with life. On the other hand, when the quantity of urine is very large, and its specific gravity far above the healthy standard, as in diabetes, the drainage from the system must be enormous, and the consequences equally serious.

According to the preceding table of M. Becquerel, the mean average quantity of urine passed by men is less than by women in a given time, as in twenty-four hours; while the specific gravity is greater. That is,

Men pass in twenty-four hours	44·7 fl. oz. of urine, sp. gr. 1018·9
Women	ditto
Means	46·5 1017·01

I cannot decidedly confirm nor deny these statements; but I believe that *ceteris paribus*, the specific gravity of female urine is rather less than that of males; though I am not prepared to admit that on the whole women secrete more urine than men. As formerly stated also, I consider that M. Becquerel's average quantities materially exceed the average quantities passed by healthy individuals in this country.

M. Lecanu concludes from his experiments that the urine of young men is greater in quantity and higher in specific gravity, than that of old men or infants. The quantity of urine passed by infants, as well as its specific gravity, are subject to all the

varieties of the same data in adults. The quantity of urine passed by a healthy child under twelve months old has varied from 12 oz. to 25 oz. in twenty-four hours, while the specific gravity has ranged inversely from 1022 to 1012 or less; and probably the averages lie between these extremes.* Generally speaking, as already stated, the specific gravity of the morning urine is less than that of the evening; the difference varying from five to ten, or even more degrees. The greatest quantity of urine is usually passed in the morning after breakfast; a circumstance probably connected in some degree with the fluid nature of that meal in this country.

M. Beequerel has fixed the physiological limits of the quantity of urine passed in twenty-four hours by the same individual between 53 fl. oz. and 28. oz., M. Leeanu found the quantity passed in this interval by thirteen individuals (eight men, four women, and a boy eight years old), to vary from 138 fl. oz. to 18 $\frac{3}{4}$ fl. oz. The quantity passed by four young men, between twenty and forty years of age, varied from 68 fl. oz. to 26 fl. oz. in twenty-four hours. These facts are mentioned to illustrate the varieties in quantity to which healthy urine is liable in the same and in different individuals; rather than as denoting the actual quantities passed by individuals in this country.

In different diseases, as has been abundantly shown in the preceding pages, the quantity and specific gravity of the urine are liable to very great variations. We cannot enter into details, but shall briefly observe that besides the diseases already mentioned, the quantity of urine, *cæteris paribus*, is much decreased, and its specific gravity at the same time much augmented by fever in general; by severe functional disorders; by copious evacuations through other channels, as the skin, bowels &c.; by diseases of the heart, when advanced and embarrassing the functions of that organ; and by diseases of the liver. Within the limits of health, as already stated, the augmentation of the specific gravity of the urine compensates for its diminished quantity, so that the portion of solid matters passed in the urine is little influenced by the change. But in most of the diseases above-men-

* The impossibility of collecting all the urine passed by young children, it must be confessed, throws some doubt on these subjects.

tioned the case is probably different; and though the specific gravity be much augmented, and the quantity of solid matters evacuated from the system be considerable, yet the proportion generally falls short of that of health; and the unnatural matters thus retained in the system add to the disorder.

The quantity of urine is of course liable to be increased, and its specific gravity in general diminished, by the free use of diluents; but the same takes place by cutaneous absorption;* also by various mental emotions; as fear; hysterical excitement; and other circumstances of a temporary character. When the increased flow of urine is permanent, cutaneous absorption is generally active; and whether the increased flow of urine be kept up beyond a certain point, by this cause, or by the too free use of fluids, the constitution is on the whole robbed of much solid matter essential to its healthy condition; for it is a well-established and most important fact, that in all instances in which the quantity of urine permanently exceeds the healthy standard, the quantity of solid matter which escapes from the system is augmented likewise.

Urea was long considered to be peculiar to the urine; but recent observations have shown that the kidney is not necessary to its existence; and that it is formed from the constituents of the blood, without the agency of that organ. The colour and other sensible qualities of the urine were formerly also ascribed to this principle. But Berzelius observed many years ago, that urea was colourless;† and in 1817 a paper was published by me,‡ in which it was further shown that this principle is not only colourless, but has no remarkable smell nor taste. The following is a summary of the properties of urea:

Urea most commonly assumes the form of a four-sided prism. Its crystals are transparent and colourless, and have a slight, pearly lustre. It leaves a sensation of coldness on the tongue, like nitre. Its smell is faint and peculiar, *but not urinous*. It is neither sensibly acid nor alkaline. Urea undergoes no appa-

* See a striking instance, page 106.

† View of the Progress and Present State of Animal Chemistry, p. 101.

‡ Med. Chirurg. Trans. viii. p. 529. The sentences quoted are from my own paper.

rent change on exposure to the air; except in very damp weather, when it slightly deliquesces; but does not seem to be decomposed. The specific gravity of its crystals is about 1.35. It fuses at 250° into a colourless fluid; and at a higher temperature is converted into ammonia, cyanate of ammonia, and dry solid cyanuric acid.*

Urea is soluble in its own weight of cold water; in every proportion in hot water; in 4·5 parts of cold, and in about 2 parts of boiling, alcohol. From the boiling alcoholic solution, as it cools, the urea separates in the crystallised form. It is very sparingly, if at all, soluble in sulphuric ether, or in oil of turpentine, though these fluids are rendered opake by it. Urea unites with several acids, but does not neutralise them. The most remarkable of these compounds are the nitrate, the oxalate, the lactate, and the lithiate ‡ of urea; † the two first of which readily crystallise. Alkalies scarcely affect urea at low temperatures, but, when assisted by heat, they rapidly convert it (together with water) into the carbonate of ammonia.

Urea was first analysed by myself, thirty years ago; and from its composition I was satisfied that it might be formed artificially. I made numerous attempts to form it, but did not succeed; and the honour of forming the first organic product artificially is due to Wöhler. ‡ Urea is supposed to be generated during the destructive assimilation of the gelatinous tissues, and probably always exists in the blood in a minute quantity. In

* Turner's Elements of Chemistry, part III. page 758, edited by J. Liebig and W. G. Turner; also Liebig's Organic Chemistry; to which works, and to Professor Graham's Elements of Chemistry, as containing the most recent experiments of this distinguished chemist, I refer the reader.

† The nitrate of urea has been long known. The oxalate of urea was first, I believe, mentioned by myself. The lactate of urea has been recently described by MM. Cap and Henry, though I long suspected the existence of some such compound; but before the nature of lactic acid was fairly determined, considered it as the *acetate* of urea. I still think that much of the urea in healthy urine is loosely associated with other principles; yet I confess that I have not been able to completely satisfy myself that the lactic acid is one of these principles; or even that the lactate of urea may be formed artificially. The same difficulty has been experienced by others.

‡ See Turner's Elements of Chemistry, above referred to. I do not know where the original paper was published.

certain diseases of the kidney, however, urea exists in the blood in considerable proportions ; a fact established by Dr. Christison,* and confirmed by many others.

The quantity of urea in 1000 parts of urine of average quality in this country, as stated in the table deduced from M. Becquerel's experiments, at page 522 is about *fourteen parts and a quarter*. According to this estimate, the mean quantity of urea voided by a healthy adult individual in twenty-four hours, will be 227 grains ; instead of upward of *twice* that quantity, as formerly stated by Berzelius. The quantity of urea, however, voided in health is liable to considerable variations ; and M. Becquerel has fixed the physiological range between about *two parts* per 1000 on each side of the mean ; that is, between *sixteen* and *twelve* parts nearly in 1000. If this estimate be admitted, the quantity of urea voided by a healthy individual may vary from 255 grs. to 191 grs. in twenty-four hours. †

According to M. Lecanu, the quantity of urea voided in a given time, as in twenty-four hours, does not differ much from the assigned limits in the *same* individual ; but in *different* individuals the quantity is subject to much greater diversity, and in a given time, may vary from less than one half to more than double

* Edinburgh Medical and Surgical Journal, 1829. When engaged in examining the blood, in the year 1816, I found urea (or a substance having most of its properties) in that fluid ; but not crediting the fact, and thinking it might be accidental, did not pursue the inquiry ; though I made a memorandum of the circumstance. I also found, in 1826, a substance very analogous to urea, in blood which had been sent to me by Dr. Bright, from a person who had suffered for three days under suppression of urine.

† M. Becquerel shows that these estimates nearly coincide with M. Lecanu's when reduced to the same mean, and corrected. M. Lecanu calculates the quantity of urea obtained from the nitrate of urea, the composition of which he assumed to be 53 urea + 47 nitric acid ; whereas M. Becquerel, following M. Regnault, considers the nitrate of urea to consist of 48.938 urea + 43.781 nitric acid, + 7.281 water. When thus corrected and reduced to the mean specific gravity assumed by M. Becquerel, the quantity of urea in 1000 parts of urine, according to M. Lecanu, will be 13.074 parts, instead of 12.102 parts found by M. Becquerel. From the number of experiments made, the care with which they seem to have been conducted, and particularly from the near coincidences thus obtained between two independent observers, the results stated are probably near approximations to the truth.

the mean quantity. Generally speaking, the quantity of urea excreted by men in the prime of life is greater than by women ; and in both sexes the quantity voided at this period is greater than in old persons or in infants. When the quantity of urine is increased beyond certain limits, the proportion of urea does not necessarily follow the same rate of increase ; hence the quantity of urea in urine of a given specific gravity cannot be always precisely stated. Nevertheless, the important fact has been distinctly established by M. Becquerel, that, *on the whole*, when the quantity of urine is much increased, either naturally, or by large quantities of diluents, the quantity of urea (as well as of the other urinary constituents) is increased likewise. Hence, as before stated, a permanently large flow of urine must be attended by an extraordinary drainage from the system.

The proportion of urea in the urine is subject to much variation from disease. According to M. Becquerel, an absolute *increase* in the proportion of urea in a given time is not common. Yet, as stated in the preceding paragraph, on the authority of the same writer, when the quantity of urine is permanently larger than natural, the quantity of urea voided must likewise exceed the normal proportion. Moreover, the specific gravity of the urine of dyspeptics, particularly after dinner, is often as high as 1030 or more ; and the proportion of urea, as well as of the other matters, is in such instances much larger than natural.* According to M. Becquerel, the absolute quantity of urea voided in a given time is liable to be much more frequently diminished than increased in various diseases. Thus in the scanty high coloured, and acid urine of fever, rheumatism, erysipelas, hepatic diseases, &c., the whole quantity of urea voided in twenty-four hours is,

* For *practical* purposes, an *excess* of urea may be shown by putting a little of the urine into a watch-glass, and adding to it 'carefully about an equal quantity of pure nitric acid, in such a manner that the acid shall subside to the bottom of the glass. The mixture must be kept as cool as possible ; and if under these circumstances a crystallised deposite be formed, an excess of urea is indicated. The degree of excess may be inferred, near enough for *practical* purposes, by the length of time which elapses before crystallisation takes place ; which may be from a few minutes to two or three hours. The detection of a *deficiency* of urea requires a more elaborate process, which will be found detailed in most recent chemical treatises.

from the small quantity of urine passed, below the healthy standard, though the quantity in a given specimen occasionally exceeds the average.

Again, when the quantity of urine voided in a given time is nearly normal, but the secretion is at the same time of a pale colour, and of a specific gravity below the healthy standard; not only the absolute quantity of urea passed in a given time, but the relative quantity in a particular specimen is below the normal proportion. Such urine is voided in most cases of anaemia, as in chlorosis, and many chronic affections; particularly if accompanied by loss of blood, &c.; and it is in extreme cases of this kind, when at the same time accompanied by fever and great constitutional disturbance, that the proportion of urea, both absolute and relative, is found most deficient; as for instance, in the last stages of granular disease of the kidney, &c. In those cases falling under the present class, in which the kidneys are sound, the urine is often deep-coloured, very acid, and becomes turbid on cooling; though its specific gravity, as well as its quantity, are below the healthy standard, and both the absolute and relative proportions of urea are very much reduced.

Lastly, in certain diseases of the urinary organs, urea is passed from the system in the form of carbonate of ammonia; or at least appears in the urine in that form.

Lithic acid, and its *derivatives*, &c.—Lithic, or *uric* acid as some choose to call it, is not found in the blood in perfect health; or if it ever exists in that fluid, in very minute quantities only; it has however been recently detected by Dr. Garrod in the blood of gouty subjects, combined with soda. This accords with what I have elsewhere stated, with respect to the deposition of gouty chalkstones in diseases of the kidneys.* Lithic acid is an invariable ingredient of healthy urine, in which secretion it exists in solution at all ordinary temperatures. In a physiological, and particularly in a pathological point of view, lithic acid is, perhaps, of more importance than any other principle. I shall, therefore, enter rather minutely into its history under the two following heads, viz. the mode in which lithic acid exists in

* See page 491 of fourth edition; and page 492 of the present.

healthy urine ; and the modifications which lithic acid is capable of undergoing.

Of the mode in which lithic acid is held in solution in healthy urine.—It has been stated, that fresh human urine reddens litmus paper ; and that, in consequence, this secretion has been supposed to contain a free acid. With respect to the nature of this presumed acid, Berzelius remarks, “As by the laws of chemical affinity the acids of the urine will unite with any alkali that may be present, and saturate themselves with it in the order of the force of their respective affinities ; it must follow, that when the quantity of alkali is insufficient to saturate all the acids present, the weakest acids must be those that will remain uncombined, and will give the urine its acid properties. These, therefore, must be the *lactic* and the *uric*.”* Thus it appears to be the opinion of this eminent chemist, that the lithic acid exists in solution (at least in part) in a free state ; and such, I believe, was formerly the general opinion. This opinion, however, long ago seemed to me to be very improbable, for the following reasons : First, according to the analysis of Berzelius, one thousand parts of healthy urine contain, in solution, one part of lithic acid ; but Dr. Henry states, that one part of lithic acid requires at 60° at least 1720 parts of water to dissolve it. How then are we to reconcile these two statements, on the supposition that lithic acid exists in the urine in a free state ? Secondly, the addition of any acid, even the carbonic acid, to the urine, as is well known, throws down the lithic acid. How is it possible to explain this fact, except on the supposition that the new acid combines with something retaining the lithic acid in solution ; and that the liberated lithic acid, incapable of remaining in solution, is precipitated in the solid form. Thirdly, there is no instance known, in which lithic acid is secreted in a free state. Birds, serpents, &c., always secrete it in combination with ammonia ; in the gouty chalkstone, lithic acid is secreted in combination with soda, &c. To suppose, therefore, that the human kidney secretes lithic acid in a free state, is to suppose an exception to a law which appears to be very general. Lastly, the lithate of ammonia exists in large proportions in human urine ; for many of the amorphous sedi-

* Med. Chirurg. Trans. iii. p. 257.

ments consist chiefly of that compound. Reflecting on these circumstances, I was induced to make some experiments which appeared to confirm the supposition that healthy urine contains no uncombined lithic acid.

Thus with respect to the solubility of lithic acid in water, I found that, when pure, about six times more water is required to dissolve it than has been stated by Dr. Henry; or at least 10,000 its own weight at 60°; a fact which adds much to the improbability of the common opinion.* On the contrary, the lithate of ammonia requires only about 480 times its weight at the same temperature; and if to the solution any acid be added, the lithate is immediately decomposed, and the lithic acid precipitated in the solid state; just as happens when the urine is similarly treated. Further, the lithate of ammonia in a state of solution reddens litmus paper; and what is singular, and scarcely would have been expected, the lithate of ammonia is likewise capable of existing in the same solution with the superphosphate of ammonia; which, as is well known, has likewise the property of reddening litmus paper. Now, as the phosphate, or rather super-phosphate of ammonia exists in healthy urine, this fact, taken in conjunction with the others, enables us to account very satisfactorily for the two important properties in question, viz., the property of reddening litmus paper possessed by the urine; and the permanent state of solution in which the lithic acid is held in solution in that secretion; both of which properties appear inexplicable on the common opinion. Further, if we evaporate healthy urine slowly, (as, for example, under the receiver of an air-pump with sulphuric acid,) the lithate of ammonia is deposited on the sides of the vessel in abundance, in the form of an amorphous sediment; whereas, if the lithic acid existed in the urine in a free state, it would be deposited in a pure crystallised form. Lastly, the supposition that the lithic acid exists in the urine in the state of lithate of ammonia, will enable us to throw considerable light on the phenomena presented by the urine in different diseases, as will be shown hereafter.

* It is difficult from their peculiar properties to determine the exact solubility of lithic acid and its compounds in water. See note, page 349; also note in next page.

Dr. Bence Jones, in a paper lately published, (*Med. Chirurg. Trans.* vol. xxvii. p. 102,) has discussed the subject of the solubility of lithic acid and its compound the lithate of ammonia, both in water and in the urine. The following are his chief results :

1. That lithic acid is soluble in 8941 parts of water at 69° ; thus nearly confirming my experiments.
2. That there is but one definite compound of lithic acid and ammonia, which crystallises in the form of small needles uniting into tufts and crosses ; and is soluble in about 1000 parts of water at 60°*. On this point I would observe, that there is undoubtedly one lithate of ammonia strongly and definitely marked ; but I am not at present prepared to admit that this is the only one. If it be, I can only say that it is capable of " playing many parts." Dr. B. J. found, what was indeed well known before, that the smallest quantity of most dilute liquor ammoniæ, or a small quantity of muriate, sulphate, or acetate of ammonia produced a deposition in a saturated solution of his lithate of ammonia. This fact has been urged by Wetzlar as a proof that lithic acid exists in the urine in a free state, and not as lithate of ammonia ; but does it not rather indicate the existence of more than one compound of ammonia with lithic acid ?
3. A solution of lithate of ammonia reddens litmus paper after the paper has been dried. A similar fact has been long known regarding many other salts of ammonia,—a property therefore in which the lithate of ammonia only participates in common with them. According to my results already stated, the lithate of ammonia reddens well-prepared litmus or cabbage paper when in solution.
4. The lithate of ammonia, when dissolved with about an equal weight of common salt, acquires a greater degree of solubility in water, and a difference in appearance from pure lithate of ammonia. The appearance is identical with that deposites which can be obtained from urine ; and the solubility is more than double the

* Dr. J. found the solubility vary in different experiments from 1 in 897 parts of water at 69°, to 1 in 1018 parts of water at 59° ; results affording a striking illustration of the effects of the cohesive crystalline attraction alluded to in the note, page 349. These results differ materially from mine, probably from a different mode of operation.

solubility in distilled water. Pure lithic acid is also rendered more soluble in water by the presence of common salt. These important facts help to explain the large proportion of lithic acid held in solution in the urine; while as Dr. J. remarks, an investigation of the effects of the other salts, and I may add of the colouring and other organic principles always present in that secretion, may help to explain the deposition of the lithate of ammonia in various diseases, which in the present state of our knowledge is often obscure.

The following is a contrasted view of the chief results:

One part of lithic acid remained in solution in 8941 parts of pure water at 68° ; but in only 7199 parts of water at 64° , when common salt was added to the water.

One part of the lithic acid was found in 2567 parts of urine at 64° ; and in 2399 parts of a solution of lithate of ammonia in distilled water at 71° , when the lithate was decomposed—a near coincidence.

One part of lithate of ammonia was found in 1000 parts of water at 65° , but in only 450 parts of water when common salt was added to the solution—; results, as Dr. J. admits, confirming the opinion I have advanced, that the lithic acid exists in the urine principally in the form of the lithate of ammonia.

Dr. Golding Bird coincides in this opinion; though he thinks that the recent experiments of Liebig throw farther light on the subject. Dr. B.'s conclusions are, "Lithic acid, at the moment of separation from the blood, comes in contact with the double phosphate of soda and ammonia, evolving phosphoric acid, which thus produces the natural acid reaction of the urine. If the whole bulk of the urine be to the lithate of ammonia formed not less than about 2701 to 1, the secretion will, at the ordinary temperature of the air, remain clear; but if the bulk of the fluid be less, an amorphous deposite of the lithate will occur. On the other hand, if an excess of lithic acid be separated by the kidneys, it will act on the phosphate of soda of the double salt, and hence on cooling, the urine will deposit a crystalline sediment of lithic acid sand, very probably mixed with amorphous lithate of ammonia; the latter usually forming a layer above the crystals, which always sink to the bottom of the vessel."*

* Urinary Deposites, &c., p. 60, second edition.

The origin assigned to the ammonia in the above opinion is different from that I have given; but I do not think the point worth contesting; and shall conclude this subject by observing, that most chemists in this country, as well as MM. Donné and Rayer in France, now admit, I believe, that the lithic acid exists in healthy urine in the state of lithate of ammonia. MM. Quevenne and Becquerel, however, still deny this point, though their reasoning on the subject seems to me to be very unsatisfactory. On the whole, I think there cannot be a doubt that the lithic acid exists in the urine chiefly in the state of the lithate of ammonia; but as already stated, a great deal yet remains to be done before all the phenomena connected with the subject can be satisfactorily explained.

Lastly, I may allude to the opinion I have expressed elsewhere, and which I still hold, viz., that like the biliary principles, the urinary principles may probably be considered as existing together as a unity or *entire principle*, easily separable into others, having reference to various simple radicals remotely included in its composition; and which tacitly exert their respective influences (according to the nature of the decomposing substance) in determining the character of the principles into which the *entire* urinary principle is to be separated.

Of the changes which the lithic acid is capable of undergoing.
—The changes which lithic acid is capable of undergoing, and its analogies and relations, have been investigated with great address by Liebig and Wöhler; and though I by no means subscribe to all they have said, or think they have completed the inquiry, I readily admit that they have made great advances on the subject. Many of the observations of these excellent chemists, respecting lithic acid, do not concern us at present; at least they cannot yet be satisfactorily applied to the explanation of urinary phenomena. Those more immediately connected with our subject are the following.

The phenomena to be first briefly noticed, are those produced by the action of nitric acid on lithic acid; and for the sake of distinctness, I shall follow Liebig and Wöhler. When one part of dry lithic acid is added in successive portions to four parts of nitric acid of specific gravity 1.45 to 1.5, it is dissolved with effervescence, and the production of heat. The heat should be

obviated, as much as possible, by placing the vessel in ice, and by adding the lithic acid slowly. Small granular crystals of a strong lustre are thus formed, and gradually the whole liquid is converted into a solid mass. By carefully drying and redissolving these crystals, it will be found, that from a warm but not perfectly saturated solution of them in water, large colourless transparent crystals containing much combined water will be obtained ; or that if a hot saturated solution be allowed to crystallise in a warm place, crystals of another shape will be formed. These last crystals, however, differ in no respect from those previously obtained, except in being anhydrous ; and they constitute the substance called *Erythric acid* by their discoverer Brugnatelli.

When one part of lithic acid is added to thirty-two parts of water, and to the boiling mixture dilute nitric acid is added in successive portions, the lithic acid will be dissolved. On evaporating the solution to two-thirds of its bulk and permitting the solution to stand for twenty-four hours, crystals will be deposited ; which, on being purified by re-solution, will be found to be nearly colourless, or of a slight yellow tint, and of quite a different form and character from the erythric acid formed by strong nitric acid above mentioned. Thus the erythric acid is very soluble in water, has a disagreeable odour, and stains the skin of a purple colour. The new crystals, on the contrary, are sparingly soluble in cold water. Both the solutions, however, reddens litmus, and have an acid reaction. The erythric acid is called, by Liebig, *alloxan*; the crystals formed by dilute nitric acid *alloxantin*, for what reason I am unable to assign. The aloxantin, according to the same chemist, differs from the erythric acid by containing one more proportion of hydrogen. With respect to these changes, I may remark, that I was acquainted with some of them, and particularly with the different forms of the crystals of erythric acid ; which I considered to depend on the different proportions of water they contained. But I was not aware that two distinct substances were generated under these circumstances ; both of which were necessary to the formation of what I termed the purpurate of ammonia. The observations, however, which I have to offer on these and other points connected with the present subject, would be quite misplaced here ; and I shall reserve what I have to say till another opportunity. It remains, therefore, only to make a few

remarks on the *purpurate of ammonia*, (the *murexid* of Liebig,) on account of the influence it has been supposed to exert on the colours of urinary deposits.

The purpurate of ammonia may be formed in a variety of ways pointed out by Liebeg, several of which were known to me. I shall only, however, observe that, according to M. Liebig, when erythric acid, alloxantin, and ammonia, are mixed together in solution in proper proportions, and with due precautions, the purpurate of ammonia is formed directly, without any excess or deficiency. The following are the properties of this remarkable principle :

The purpurate of ammonia, crystallises in short four-sided prisms, two opposite faces of which reflect a beautiful green metallic lustre. They are transparent, and by transmitted light are of a garnet red colour. The purpurate of ammonia is sparingly soluble in cold, but more readily soluble in boiling water, from which it is deposited in the crystallised form unchanged. The solution does not possess acid or alkaline properties. As the name implies, I considered this substance to be a compound of an acid (purpuric acid) and ammonia.* Liebig, however, asserts that it is a distinct substance, and that the principle I termed purpuric acid, (which he calls *murexan*,) is not an acid. For a very long time I have been aware that it was not *the* acid, as it exists in the purpurate of ammonia—a circumstance that first attracted my notice from observing some remarkable changes it undergoes on exposure to air and moisture. For the reasons, however, so often stated, I cannot enter further on the subject here, and proceed to consider the pathological relations of the purpurate of ammonia,—a name which for the present I retain.†

* See Philos. Trans. 1818, page 420, where I first described this substance. Since Liebig's opinion was published, M. Fritzche has endeavoured to show, that the purpurate of ammonia is really a saline compound. See London and Edin. Philos. Mag. vol. xv. 491, (1839.)

† Besides the preceding substances formed from lithic acid, M. Liebig has described a variety of others, under the following extraordinary names ; *Alantoin*, *cyanuric acid*, *cyamelid*, (or insoluble cyanuric acid :) *Alloxanic acid*, *Mesoralic acid*, *Mykomelinic acid*, *Parabanic acid*, *Oxaluric acid*, *Thionuric acid*, (containing sulphur,) *Uramil*, *Uramilic acid*, &c. Some of these deserve a brief notice, as they influence the phenomena presented by the

The compounds of lithic acid usually denominated *lateritious* and *pink* sediments were supposed by Proust to constitute a peculiar acid which he named the *rosacic acid*. These well-known sediments have been usually found to consist essentially of the *lithate of ammonia*, and sometimes of the *lithates of soda and of lime*, in small proportions. They owe their colour partly to the colouring matter of the urine, and partly to some modification of the purpurate of ammonia. As this latter point, however, has been controverted by Berzelius and others, it remains to make a few remarks on the subject.

It is, I believe, generally admitted, that the urine occasionally urine in many instances. The *allantois* of Liebig is the *allantoic acid* of Vauquelin and Buniva. It may be formed artificially, together with urea and oxalic acid, by boiling lithic acid with the peroxide of lead in water. It occurs naturally in the allantoic fluid of the cow. When urea is submitted to heat, or lithic acid to the destructive distillation, the acid principle formerly termed *pyrouric acid* by Scheele, is formed, to which Liebig has given the name of *cyanuric acid*. Besides *cyanuric acid*, there is also formed, under these circumstances, *urea*, *cyanelid*, (or insoluble cyanuric acid,) also hydrocyanic acid, a little carbonate of ammonia, and as a residue, a brown carbonaceous substance, rich in azote. These observations are quoted—first, with the view of pointing out the relations between urea, lithic acid, and oxalic acid, and their compounds, and which doubtless depend on the still remoter analogies between the gelatine and albumen from which they are formed ; and secondly, for the sake of showing the possibility, as well as the probability, that in various diseases, urea, lithic acid, and oxalic acid may be converted into each other. I consider, however, that such conversions, even supposing them to exist, are to be viewed as exceptions, rather than the rule ; and that urea, lithic acid, and oxalic acid, are *usually* formed in the modes we have attempted to point out in this volume. Judging from the description given of them, I may remark, that I was previously acquainted with some of the substances above mentioned, as well as others not described by Liebig ; and that before I subscribe to the accuracy of their analyses, such analyses must be better authenticated than they are at present. I must protest also against the barbarism of the terms ; particularly as I am by no means satisfied that the doctrines on which they are founded, are satisfactorily established.

I have permitted the preceding to remain, because I still believe that the true nature of the lithic acid and its compounds is not at present understood ; nor moreover can be understood, till the fundamental relations of what are called the atomic weights of hydrogen, carbon, oxygen, and azote, are duly taken into account. The same remark applies to most organic compounds. See Bridgewater Treatise.

contains nitric acid in some unknown state of combination, and I have myself found it in combination with pink and lateritious sediments.* The effects of nitric acid on lithic acid have been already stated; and we have now to make a few remarks on the supposed effects of nitric acid with reference to the colouring matters of the urine.

In the former editions of this volume, I remarked that the colouring matters of the urine appeared to be of two kinds, one having a great affinity for the lithate of ammonia and lithic acid, and imparting to them their yellow colour; the other of a less distinct or well marked character, yet apparently closely connected with the preceding in its nature and properties. I also remarked, that these colouring principles of the urine seemed in some way to be intimately connected with the formation of lithic acid; as they were apparently absent in those forms of disease in which the lithic acid was also either deficient or absent; as in serous and phosphatic urine, &c. Now, in consequence of the assertion of Berzelius and others,† that the pink and lateritious sediments of the urine do not owe their red colour to the purpureate of ammonia, I have been induced to examine a little more closely into the properties and phenomena presented by the yellow colouring matters of the urine above mentioned; and have found that nitric acid produces nearly the same effects, as regards colour, on them, as it does on lithic acid itself; at least on one of the two forms of the colouring principle above mentioned, (for I still believe that there are two, if not more distinct forms or modifications of the yellow colouring principle of the urine, intimately related to each other.) These yellow colouring principles I have never been able to isolate so completely as to obtain them in a state of purity; but their properties appear to indicate that they are most intimately related to lithic acid on the one hand, and to some modified condition of the colouring matter

* Med. Chirg. Trans. ix. p. 481. I have supposed, for the sake of distinctness, that the nitric acid is the cause of the development of the red colour; but the red colour may probably be developed both from lithic acid, and from the yellow colouring matter of the urine, by other agencies acting on the same principle of oxygenation, which seems in some way to be necessary to the change.

† See Medical Gazette, 1834.

of the bile on the other.* Now it is remarkable, as we have stated, that the colouring matter of the bile so far resembles lithic acid, as to assume a purple tint by the action of nitric acid.† The inference therefore is, that the red colour of the urinary sediments is sometimes partly due to the action of the nitric acid on the yellow colouring matters of the urine—in short, that the lateritious and pink sediments of the urine partly depend on the purpuree of ammonia, or some modification of this compound, and

* Some of the yellow colouring matters of the urine appear to be so intimately connected with the lithic acid, that one is almost induced to believe that the two substances gradually run into each other. This intermediate kind of principle seems either to possess or to exert peculiar effects on the lithic acid, so as to apparently render it more soluble in the urine. Has the xanthic or lithic oxide, to be presently described, anything to do with the matter? I may point out a further analogy between the yellow colouring matter of the urine and that of the bile, alluded to in the text, namely, its property of acquiring a *green* tint. Thus the greenish tint often exhibited by mulberry calculi, and by the urine during the oxalate of lime diathesis, is nothing but another form of the common yellow colouring matter of the urine; and such greenish urine will often, like certain modifications of yellow urine, immediately acquire a purple tint on the addition of nitric acid. On a careful review of the opinions here expressed, while I acknowledge their imperfection, I do not see any reason to doubt their correctness as far as they go. I have for many years been acquainted with the facts brought forward by Berzelius, and more lately enforced by Dr. Golding Bird and others; but as opposed to what I have observed on the subject, during the last twenty years, these facts appear to me to have little or no weight; their chief defect is that they do not apply to the colouring matters, *per se*, but to those colouring matters in uncertain states of union with uncertain matters.

Another colouring principle, apparently connected with lithic acid, has been found in one instance by Dr. Marçet in a specimen of *black* urine, and for which, from its properties, the term *melanic* acid has been proposed. See Med. Chirurg. Trans. xii. 37. Instances of *black* urine have been frequently alluded to by authors; and indeed, a condition of the urine which would be vulgarly called *black*, is not very uncommon in hysteria, as well as in other affections. I have often seen the common lithate of ammonia sediments so deeply tinged, as to appear to the eye almost black, when viewed in an opaque vessel.

† See p. 510. Berzelius supposes the colouring and other indefinite matters associated with the lactic acid to be the result of the secondary destructive assimilation; in short, that they constitute the effete débris of the body.

partly on the yellow altered principle of the urine; that in different instances, and in different diseases, the two red colouring matters thus produced, are mixed in various proportions; and finally, that the one or the other colouring matter predominates, according to the nature of the disease.

After mentioning my own opinion on the colouring matters of the urine, it is right that I should mention the opinions now most prevalent, viz., that the colouring matter of the urine "bears no analogy whatever with *murexid* or *purpurate of ammonia*," and that this want of identity is so clearly made out, that Dr. Golding Bird, whom I quote, has deemed it unnecessary to adduce the evidence brought forward in his first edition on the subject.* Dr. B. calls this colouring matter *Purpurine*, and thinks it may be precipitated from boiling urine by muriatic acid. He describes this principle as being readily soluble in weak alcohol, communicating to it a yellowish pink colour, and as being remarkable for the facility with which it unites with the lithate of ammonia." He considers the principle thus obtained identical with the *uro-erythrine* of Simon, and *ur rhodin* of Steller.

The most promising experiments I have seen on the subject, are those of Scherer, quoted by Dr. G. Bird. Scherer supposes the colouring matter of the urine to be the "direct result of the destructive assimilation of old blood corpuscles." This approximates to my views. Long and close attention to the relations between the colouring matter of the blood, of the bile, and of lithic acid and its products, have satisfied me that the colouring matter of the urine is to be sought for among their relations; and that the opinion I have expressed, or something very like it, will be ultimately established. Chemists at last seem to be on the "right scent," and I have no doubt will in time arrive at the truth. Before the problem can be solved, however, fundamental principles at present overlooked, must be involved. I may at a future time offer some remarks on the subject; in the mean time, like the almanack makers, I must leave it "to time and the curious to construe."

The next, and perhaps the most important, form in which lithic acid appears in the urine, is that of lithic acid gravel. The reader is referred to the former parts of this volume for

* See Urinary Deposites, second edition, page 73, et seq.

the pathological history of this important form of lithic acid deposite, and it only remains here, to make a few remarks on the cause of the deposition of lithic acid in the free state.

We have already stated, that the addition of any acid, even the carbonic acid, to healthy urine, will cause a deposition of the lithic acid in the crystallised form—a fact clearly proving that healthy urine, though it possesses an acid reaction, contains in reality no uncombined acid. When, therefore, the lithic acid is deposited from the urine in the crystallised form, the inference must be, that a free acid exists in the urine; and the question is, what is the nature of this acid? The answer, I believe, to this question is, that in the great majority of instances, the immediate cause of precipitation of lithic acid gravel is the lactic acid. In some instances, the mineral or other acids may be the *remote* cause of the precipitation; that is, such acids may, from their stronger affinities for the bases present, combine with them and separate the lactic acid, which may thus act immediately as the precipitant, as just stated. In the greater number of instances of lithic acid gravel, however, the acid seems to be actually secreted in excess; either separately, which is comparatively rare; or in a state of combination with urea or other matters, which seems to be the rule. Now, as urea, and perhaps the other matters, has little or no neutralising power, the lactic acid thus associated still exerts its acid powers, and by detaching the lithic acid from its natural state of combination with ammonia, precipitates it in the form of crystallised gravel. This view of the subject leads to the explanation of another pathological fact, viz., the frequent presence of sugar in urine depositing lithic acid gravel; and *vice versa*, the frequent appearance of lithic acid gravel in slight forms of diabetic disease. The lactate of urea, and the saccharate of urea, are in fact but modifications of the same substance, and may both be considered as the representatives of gelatine; the lactic acid being, as we have said, only a modification of the saccharine principle. Hence, by very slight variations in the action of the vital affinities, the acid or the sugar may predominate and give occasion to the phenomena in question. These remarks are also further interesting, since they illustrate certain facts mentioned in other parts of the volume, viz., that the appearance of sugar with lithic acid deposits, is an

unfavourable symptom; while, on the other hand, the deposition of lithic acid gravel and of the lithate of ammonia in diabetic urine may be considered as favourable. In the first of these cases, a natural product, the lactate of urea, has given way to an unnatural product, the saccharate of urea; while in the second, the unnatural saccharate of urea, has given way to the natural products, the lactate of urea and the lithate of ammonia,—facts showing that both the gelatinous (saccharine) and albuminous matters are at least partly assimilated.

The lithic acid is undoubtedly of albuminous origin; the lithate of ammonia being, as we have said, very probably the immediate principle formed from the albumen. The lithic acid as well as the lithate of ammonia, soda, &c., are perfectly white when pure; and for the forms which they usually assume in the urine, the reader is referred to plate I. Lithic acid may be readily detected in all its states of combination by the development of the purpure of ammonia, on the application of nitric acid and heat.

In different diseases the absolute as well as the relative proportions of lithic acid are liable, as we have stated, to considerable variations both in excess and deficiency. Besides those mentioned, the following are some of the most remarkable facts connected with this subject, as observed by M. Becquerel.

M. Becquerel has fixed the physiological limits of the proportion of lithic acid in 1000 parts of healthy urine between 3 and 5 parts; that is, the whole quantity of lithic acid voided by a healthy individual in twenty-four hours, may vary between $4\frac{1}{2}$ grs. and $7\frac{3}{4}$ grs.; taking these proportions as our standard, the quantity of lithic acid in the urine will be generally found augmented, both positively and relatively, under the following circumstances.

First. Fever in general, whether idiopathic, or produced by deep-seated functional, or organic disease, is generally accompanied by an excess of lithic acid in the urine.

Secondly. In affections of the liver and spleen more especially, whether acute or chronic, the urine is almost always deep-coloured and charged with a great excess of lithic acid.

As illustrative of the first of these propositions, we may say that in a case of acute rheumatic fever, M. Becquerel found the proportion of lithic acid in 1000 parts of urine to be upwards of

four times the normal quantity, while the absolute quantity passed in twenty-four hours was nearly in the same proportion. In a case of milk fever in a female, 1000 parts of urine contained very nearly *seven* times the normal quantity of lithic acid: and in this case, although the quantity of urine passed in twenty-four hours was reduced to one-third, yet the quantity of lithic acid passed in that period exceeded by twice and a half the healthy proportion.

As illustrative of the influence of hepatic disease, &c., in increasing the proportion of lithic acid secreted by the kidneys, we may observe that, in a case in which both the liver and heart were affected, M. Becquerel found the proportion of lithic acid in 1000 parts of urine to exceed the normal quantity by more than four times; and although the quantity of urine in twenty-four hours was reduced to nearly one-fourth of the natural standard, yet the whole proportion of lithic acid passed in twenty-four hours considerably exceeded the healthy standard.

In cases of the preceding description, though the quantity of urine may not be much increased, yet the specific gravity, and consequently the proportion of lithic acid, are liable to be decreased by various agencies, such as by active purging, blood-letting, &c. Hence, after such treatment, the proportion of lithic acid sometimes deviates but little from the normal quantity, even though, as just stated, the urine remains concentrated, and the proportion below the natural standard.

The affections usually connected with a *diminished* proportion of lithic acid are those of anaemia and debility in general; such, for instance, as chlorosis, a state of convalescence after a severe attack of typhoid fever or other acute disease; also long-continued bad health, connected with granular disease of the kidney, &c. Thus, in a case of chlorosis, in which the quantity of urine passed deviated little from the standard, M. Becquerel found both the relative as well as absolute proportion of lithic acid diminished to nearly one-fifth. This may, perhaps, be considered an extreme instance in a sound state of the kidneys. But in the very last stages of granular disease of the kidneys, the proportion of lithic acid appears to be still less, and sometimes almost to disappear.

It is remarkable, as we have stated in various parts of this-

volume, that the increase and diminution of the colouring matters of the urine follow nearly the same laws as the increase and diminution of the lithic acid. Urines containing large proportions of lithic acid for instance, are for the most part deep-coloured; and *vice versá*, urine containing but little lithic acid, as the urine of chlorosis, the last stages of granular disease, &c., is as invariably deficient in colouring matter. I draw attention to this circumstance here, as offering an argument in favour of the opinion formerly expressed, viz. that the animal principles contained in the urino exist together as a unity, or *entire* principle, like those of the bile.*

The colour of the urine, as already noticed, is affected by many substances taken as food or medicine, as by rhubarb, beet-root, &c.

* The following table presents a view of the composition of urea, lithic acid, and some of the compounds of lithic acid as now admitted.

	Hydg.	Carb.	Oxyg.	Azote.	Authority.
Urea . . .	6·66	20·00	26·66	46·66	
Lithic acid . .	2·44	36·08	28·12	33·36	Wöhler and Liebig
Alloxan . . .	2·57	30·33	49·09	17·96	Do.
Alloxantin . . .	3·111	30·858	48·362	17·669	Do.
Murexid or { Purpurate of ammonia {	3.115	34·425	29·34	33·12	Do.
Colouring matter of urine . . . } urine . . . }	5·16	58·43	27·58	8·83	Scherer.

While this is passing through the press I have seen an abstract of the paper read lately before the Med. Chirurg. Society, by Dr. Garrod, "On certain Pathological Conditions of the Blood and Urine in Gout, Rheumatism, and Bright's Disease." His chief conclusions are—

1. In Gout the blood always contains lithic acid, which may be crystallised from that fluid in the form of lithate of soda.
2. That the lithic acid is diminished or absent in the urine immediately preceding the gouty paroxysm.
3. That in patients subject to chronic gout, with chalkstone deposits, the lithic acid is always present in the blood, and deficient in the urine both absolutely and relatively to the other organic matters; and that the chalk-like deposits appear to depend on an action in and around the joints, &c., vicarious to the lithic acid secreting functions of the kidneys.

Smell of the urine.—Of the other sensible qualities of the urine arising from its constituent principles, we shall only notice the peculiar *smell* of the secretion. This has never been satisfactorily explained; but it is probably connected with some indefinable compound, into which sulphur, phosphorus, and azote, largely enter. The smell of the urine also, as is well known, is liable to be much affected by various articles taken into the stomach, as asparagus, turpentine, &c.

Kreatine and *Kreatinine*, two substances said by Liebig to exist in the urine, and not noticed in the preceding analyses; have been already alluded to when speaking of the blood.

Kreatine was discovered by Chevreul in 1835 in the flesh of animals, and its properties have been lately particularly investigated by Liebig, who has found it in the urine. This principle, when pure, exists in the form of colourless, transparent and lustrous crystals, soluble in 74·4 parts of cold, but much more soluble in boiling water. Soluble also in about 9410 parts of alcohol. The aqueous solution has a weak bitter taste, followed by a

4. That the blood in gout sometimes yields a small amount of urea when no albumen is present in the urine.

5. Healthy human blood yields only a trace of lithic acid; in the blood of the sheep and pigeon none could be detected.

6. In acute rheumatism only a trace of lithic acid is found, and no urea.

7. In Bright's disease the blood contains variable quantities of lithic acid and much urea. The kidneys in this disease are always deficient in the power of throwing off urea; and in the last stages, of excreting lithic acid also; while in the earlier stages the power of the kidneys to throw off lithic is little affected.*

With respect to these conclusions it may be observed that Berthollet and Berzelius long ago observed a deficiency of lithic acid in the urine before an attack of gout; and that in the last edition of this work I had noticed that those subject to gouty chalk-stones usually labour under diseased kidneys, which I supposed prevented the due excretion of that substance.†

In various parts of this work I have spoken of lithic acid as being characteristic of gout, and the lactic acid of rheumatism. At any rate I agree with Dr. G. that lithic acid has little to do with pure rheumatism; though it is often present in what is called rheumatic gout.

* Lancet, Feb. 26, 1848, p. 231.

† See page 491 of fourth edition, and page 492 of the present.

somewhat acrid sensation in the throat. It is perfectly neutral, and readily suffers decomposition by the presence of any organic matter. By the action of the strong mineral acids and heat, kreatine is converted into

Kreatinine, a colourless crystalline substance, more soluble in cold water than kreatine ; one part of kreatinine being soluble in 11·5 parts of water only, and in much less of hot water. It is also soluble in alcohol ; 1000 parts of alcohol at 60°, dissolving 9·8 parts of kreatinine. Kreatinine is a powerful alkaline base, and readily combines with acids, forming with many of them crystalline compounds. It expels ammonia from ammoniacal salts. Kreatine and kreatinine both exist in fresh human urine, and were indistinctly indicated by Pettenkofer some years ago. Liebig has ascertained that during the putrefaction of the urine kreatine disappears, but that kreatinine remains little affected. By further treatment kreatinine is converted into another basic compound, to which Liebig has given the name of *Sarcosine*. He has also extracted from the juice of flesh containing kreatine, &c., another acid called *Inosinic*.*

Mucus.—The last substance of organic origin usually existing in healthy urine, is the mucus, derived from the various urinary passages, and particularly from the bladder. Mucus, from different sources, and as modified by disease, differs very considerably in its properties ; and even in its healthy state and most perfect form, it must be considered as a very ill-defined principle ; at least in a chemical point of view. Generally speaking, mucus is insoluble in water ; though it possesses the property of absorbing a large proportion of that fluid ; which renders it transparent, and causes it to assume a glairy appearance. Mucus also is imperfectly soluble in acetic acid ; and is not coagulated by boiling. These properties sufficiently distinguish mucus from albuminous

* See "Liebig's Researches on the Chemistry of Food." The following, according to him, is the composition of kreatine and kreatinine.

	Hydrog.	Carbon.	Oxygen.	Azote.
Kreatine (crystallised) {	7·38	32·22	32·21	28·19
Kreatinine	6·19	42·48	14·16	37·17

matters. In diseased states of the bladder, enormous quantities of mucus are sometimes separated ; and in this case, the properties of the secretion differ considerably from those of healthy mucus ; though I am not aware at present of any chemical tests that will give us much assistance in distinguishing the various diseased states of mucus from each other. Mucus indeed, in some forms of disease, either contains albumen, or resembles the albuminous principle in its properties ; and in this case, it not only becomes more soluble in acetic acid, but exhibits phenomena with other tests, more or less analogous to those of albumen. The appearances presented by mucus in various forms of disease are such that they hardly admit of description, and can be only learnt by experience. Those, however, who will take the pains to study the phenomena presented by mucus under different circumstances, by means of the microscope, will find the forms assumed by this principle of great use in diagnosis. Mixed or associated with the mucus in the urine, there may be generally seen portions of the *Epithelium* lining the mucous passages. In certain forms of disease, this epithelium is not only much increased in its quantity, but modified in its appearance, so as also to present various instructive phenomena. Some further remarks will be made on mucus, when we come to speak of pus.

The reader is referred to the microscopic phenomena presented by mucus and pus for further information on this subject. See page 182, *et seq.* Also plates iii and iii* of this volume.

We have next to consider the mineral incidental principles and their compounds, found in the urine.

Chlorine. Muriatic Acid. Muriates.—The muriatic acid occurs both in the blood and in the urine, in combination with soda and potash, which salts, therefore, appear to pass through the kidneys unchanged. In combination with ammonia, muriatic acid exists only in the urine. The muriatic acid and its compounds appeared formerly to be of less importance in a pathological point of view, than any other similar principles existing in the urine ; but since it has been shown that free muriatic acid exists in the stomach in certain conditions of that organ, it has been inferred that this acid may occasionally cause the precipitation of lithic acid in the urine. I do not mean to say that the muriatic acid is ever the *immediate* cause of the precipitation of

the lithic acid. In most instances, it probably acts like the phosphoric, sulphuric, and other acids to be presently mentioned, viz., by liberating the weaker acids ; which are thus enabled to act in their turn and separate those having still weaker affinities than themselves. Thus, in the present instance, the muriatic acid may be supposed to separate the lactic, and the lactic to precipitate the lithic acid, &c.

The average proportion of chlerine in 1000 parts of urine, according to M. Becquerel, is .591 parts ; while a healthy person, according to his data, voids about 9.0 grs. in twenty-four hours. In a natural state of the system, the whole of this chlorine, as before stated, is probably in union with alkaline bases. The quantity of chlorine is liable to considerable variations, according to the nature of the food, &c. Thus, when salted meats, &c., are chiefly used, the proportion of chlorine is greater than in health. On the contrary, the urine of those chiefly subsisting on vegetables often contains a diminished proportion. In some instances, indeed in all instances in which I formerly made the experiment, I found the quantity of muriatic acid exceedingly diminished, and sometimes even almost entirely wanting in the urine of persons in the last stage of chronic diseases, and at the point of death.* Now, though this circumstance might unquestionably be partly referred to the diminished quantity of common salt for some time previously taken ; there can be no doubt that the absence of muriatic acid was referable in a much greater degree to the total inactivity or annihilation of the functions of the assimilating organs.

Chlorine or muriatic acid may be shown to exist in the urine, by the white curdy precipitate, insoluble in nitric acid, occasioned by the addition of the nitrate of silver to the urine ; after the sulphuric and phosphoric acids have been removed by the nitrate of barytes or of lead.†

* M. Becquerel has called this circumstance in question ; and it may not be of constant or necessary occurrence ; though, under the circumstances stated, it appears to be not unfrequent.

† The fluoric acid has been said, by Berzelius, to exist in the urine, combined with lime, in minute quantity ; but as far as I know, this observation has not been verified by any other chemist.

Sulphur. Sulphuric acid. Sulphates.—Sulphur exists in the blood in small quantities apparently as an incidental element of the albuminous principle. Sulphur appears also to exist in some peculiar state of combination in the urine; but by far the greatest proportion of this principle exists in the urine as sulphuric acid, in combination of course, with the alkaline matters present. Sulphur was not formerly known to enter into any morbid product of urinary origin; but it has recently been ascertained to form a constituent of the rare concretion termed *cystic oxide*, to be presently described. The urine seems to contain sulphur in some other form than that of sulphuric acid, in which state the greater part of the sulphur exists; but the exact nature of this state of combination is unknown. The relative quantity of sulphuric acid in the urine does not appear to vary so much as some of the other principles; and hence it is probably seldom the remote cause of lithic acid deposits. The presence of sulphuric acid in the urine, may be shown by its yielding a precipitate insoluble in nitric acid, on the addition of the nitrate of barytes.

The proportion of sulphuric acid in 1000 parts of urine, according to M. Béquerel, is 1.006 parts. Hence in twenty-four hours on an average, a healthy person voids about 15.39 grs. As stated above, the relative proportion of sulphuric acid in the urine does not appear to be subject to much change; but the absolute quantity is subject to the same variety as the fixed principles in general. The chief source of the sulphur and sulphuric acid in the urine is probably the albuminous principles, of which sulphur is an incidental element.

Phosphorus. Phosphoric acid. Phosphates.—Phosphorus, like sulphur, exists in minute quantity both in the blood and in the urine; and like that substance also, is an incidental element of some of the constituent principles of these fluids.* Phosphoric

* Phosphorus exists in singularly large proportion in the nervous mass, which of course is formed from the blood. The exact state, however, in which phosphorus exists in the blood, is not known; though its presence in that fluid cannot be doubted; unless we suppose the phosphorus to be generated during the secondary formative assimilating processes. My belief, however, is, that this supposition is unnecessary, and that phosphorus is derived *ab externo*, and exists as an incidental element in one or more of the ulterior principles elaborated during the secondary formative assimilating processes; which ulterior principles, from the relatively small quantity in which

acid was formerly supposed to exist in very small quantity, if at all in the blood. But Liebig has attempted to show that it is always to be found in that fluid in union with soda; and that on this phosphate of soda depends the alkalescent reaction of the blood, and its power of absorbing carbonic acid, which it gives out in the lungs during the act of respiration—a function formerly ascribed to the carbonate of soda. Phosphoric acid exists in healthy urine, according to the best analyses, in somewhat less proportion than sulphuric acid. In a pathological point of view, phosphorus and its compounds particularly claim our attention. I am not acquainted with any state of disease distinguished by the positive absence of phosphorus or of its compounds with oxygen; but an apparent excess of this principle, or at least of its acids, is present in certain forms of disease. The acids of phosphorus, however, only become formidable, when the earthy bases, lime and magnesia, are secreted in greater abundance than natural; which, by combining with the acid, form insoluble salts, and thus give occasion to one of the most distressing species of gravel and calculus.

According to M. Béquerec, 1000 parts of urine contain on an average 373 parts of phosphoric acid. Hence a person in health passes in twenty-four hours about 5.72 grs. The deviations from the mean are probably considerable, particularly in disease; but these limits have not been ascertained. In general, a larger proportion of phosphates is passed some time after eating, part of which excess is doubtless derived from phosphates incidental to the food. The quantity also is liable to be much varied by many other causes.*

In healthy urine, the phosphoric, like the sulphuric acid, ap-

pears to be formed, and from the circumstance of their being appropriated almost as soon as produced, have hitherto escaped observation. Much yet remains to be done with respect to the blood, which can be only successfully accomplished by one, who is thoroughly versed in physiology as well as in chemistry.

Instances are on record, in which the urine has contained so much phosphorus, as to render objects dipped in it luminous in the dark. See Ephem. Nat. Cur. Dec. I. Ann. vi. and vii. Obs. 193. Also Ann. de Chimie, Feb. 1814.

* See page 303, *et seq.*

pears to exist principally in union with soda, potash, and ammonia; and partly with magnesia and lime; and when we speak of these alkaline and earthy bases, we shall make a few further remarks on their combination with phosphoric acid.

Phosphoric acid may be shown to exist in the urine, by its yielding, with the nitrate of barytes, a precipitate soluble in nitric acid; and again precipitable from its state of solution in that acid by ammonia, without decomposition.

Soda. Potash. Ammonia.—The two fixed alkalies, as before stated, exist both in the blood and in the urine. In the blood, soda appears to occur in combination with albuminous and other matters, and with phosphoric acid and muriatic acid. In the muscles potash exists in combination according to Liebig with laetic acid, the acid being in excess. Soda and potash exist in the urine with the sulphuric, phosphoric, muriatic, and, according to Berzelius, the laetic acids. Ammonia exists only in the urine in combination with the muriatic, phosphoric, and lithic acids. The average proportion of potash in 1000 parts of urine, according to M. Bequerel, is 1.529 parts. Hence a person in health voids in twenty-four hours about 23.40 grs.

I am not aware of any disease connected with a positive deficiency of the alkalies in the urine; but an excess, both of the fixed and volatile alkalies is often present in that secretion. An excess of the fixed alkalies, or at least of their combinations, is occasionally present in the urine in certain severe organic affections of the bladder, &c., and such an excess of the fixed carbonated alkalies is always accompanied by an excess of the carbonate of ammonia. An excess of the carbonate of ammonia alone is frequently present in the urine; and in both these cases, but particularly when the fixed alkaline carbonates are also in excess, the urine has an alkaline reaction at the moment it is passed. This excess of the carbonated alkalies, both fixed and volatile, is often connected with an excess of the earthy phosphates, to be described in the next paragraph; but in some severe forms of disease, the alkaline carbonates exist alone, or at least without any excess of the earthy phosphatic salts. The carbonate of ammonia in the urine, as already stated, is only another form of urea, from which it is produced, either by the action of the fixed alkalies, or by other causes.

Lime. Magnesia. Silex.—Lime and magnesia exist both in the blood and in the urine ; but in very different states. In the blood, they appear to enter, as incidental elements, into the composition of the albuminous principles; and therefore cannot be obtained without combustion. In the urine, they occur in the saline state, chiefly as before observed, in union with the phosphoric acid, and, according to Berzelius, with a little fluoric acid. The average proportion of soda, lime, and magnesia, in 1000 parts of urine, is 4·638 parts. Hence in twenty-four hours there escape from the system about 70·99 grs.

I am not acquainted with any disease characterised by a deficiency of earthy matters in the urine ; but the most distressing and dangerous form of calculous complaints is connected with, and indeed immediately arises from, their apparent *excess* ; namely, the deposition of the earthy phosphates. In this form of calculous disease, the earthy bases seem to be deposited in much greater quantity than usual ; a circumstance indicating, as we have elsewhere stated, the extraordinary mal-formation or destruction of the tissues to which they are incidental. At the same time, the quantity of phosphoric acid seems to be relatively diminished, a circumstance not depending on a deficiency of phosphorus, which appears, like the earthy bases, to be even separated in greater quantity than natural ; but on some defect in the oxygenating operation of the kidneys, by which that principle is permitted to pass through them unchanged. When the earthy bases and phosphorus are in excess, urea is commonly at the same time present in the urine in abundance, but in some unusual state which renders it exceedingly prone to decomposition ; so that either spontaneously, or by the reaction of the alkaline and earthy matters present, it is converted into the carbonate of ammonia. The ammonia precipitates the phosphate of lime, and at the same time combines with the phosphate of magnesia, and forms the insoluble triple phosphate.

Urine containing the phosphates in solution, often becomes turbid on the application of heat, a circumstance with which I was long acquainted, before it was publicly pointed out by Mr. Brett.* This phenomenon, before its nature was ascertained, often

* See Med. Gazette, xvii. p. 793, &c.

led to mistakes ; the turbidity being ascribed to the presence of albumen in the urine.

The phosphates of lime and magnesia may be shown to exist in the urine, by the addition of ammonia. This alkali precipitates the two salts together ; and in order to separate them they must be removed and redissolved in dilute nitric acid ; from which solution (provided the acid be not in great excess) the lime may be precipitated by the addition of oxalate of ammonia ; and the triple phosphate by the subsequent addition of pure ammonia. The same purpose may be accomplished in other modes.

Silex has been stated to exist in the urine, and even to form urinary sediments and concretions, in some instances. I have many times had silicious sand and concretions brought to me as urinary products ; which, on minute examination and inquiry, I have found to be distinctly of mineral origin. This for a long time made me sceptical on the point ; but Dr. Venables* and Dr. Yellowly† have described concretions containing silex. Berzelius supposes that the small quantity of silex which he found in the urine was derived from the water drunk. This earth may be detected by its well-known refractory qualities.

Perhaps it may not be amiss, even at the risk of some repetition, to briefly recapitulate the leading points noticed by M. Becquerel respecting the proportions of organic matter, (excluding lithic acid and urea,) as well as of inorganic compounds present in the urine, and the most remarkable deviations to which they are liable in disease.

Under the head of "*Organic matters existing in the urine, and incapable of being separated,*" M. Becquerel includes *lactic acid, lactate of ammonia, colouring matters, extractive matters, and muriate of ammonia* ; the proportions of which, taken together, he has estimated in 1000 parts of urine, to be on the average 10·167 parts ; so that a healthy individual voids in twenty-four hours 146·467 grs. of these substances. The quantity of these matters, however, even in health, is liable to considerable variations ; and M. Becquerel has stated the physiological limits to

* Quarterly Journal of Science, N. S. 1829.

† Brande's Manual of Chemistry, ii. 645.

vary between seven and ten parts in 1000 parts of urine and 101 grs. and $146\frac{1}{2}$ grs. in twenty-four hours.

The proportion of these organic matters in 1000 parts of urine, is usually much increased in cases, of fever and in various diseases connected with great constitutional disturbance. Thus in a case of erysipelas of the face, accompanied by fever, the proportion of these organic matters in 1000 parts of urine was nearly double that of the healthy proportion; while the quantity passed in twenty-four hours was about one half greater. Frequently, however, owing to the great diminution of the quantity of urine, though the proportion of colouring matters in 1000 parts of urine far exceeds the average, the absolute quantity passed in twenty-four hours falls short of the average. Thus in a case of milk fever, the absolute quantity of the matters passed in the time stated was below the mean, while the proportion in 1000 parts of urine was considerably more than double the average. In the latter and convalescent stages of the above affections, as well as in certain chronic diseases, the proportion of organic matters, though maintaining its proportion in 1000 parts of urine, is often very much diminished on the whole. Thus in a case of chlorosis, accompanied by debility, though the quantity of organic matters in 1000 parts of urine was about the average proportion, yet the whole quantity passed in twenty-four hours was reduced to one half only. On the other hand, in some of those cases in which the quantity of urine is not materially diminished, the proportion of organic matters in 1000 parts of urine, as well as the absolute quantity passed in twenty-four hours, are both slightly below the average. The greatest diminutions, however, are observed in cases of anaemia and general debility, in which the quantity of urine is nearly normal, but its specific gravity is far below the standard of health. Thus in the urine of an individual in a state of convalescence from typhus fever, the proportion in 1000 parts, as well as in twenty-four hours, was about one half the average. In this case the specific gravity of the urine was only 1008.4, and the quantity nearly normal. On the other hand, in a case of polydypsia, in which the specific gravity of the urine was only 1006.3, but its quantity more than double the average, the proportion of organic matters in 1000 parts of urine was less than one half, while the whole quantity passed in

twenty-four hours was nearly normal. A fact strikingly illustrating the influence of an increased quantity of urine.

M. Becquerel has thrown no new light on the nature of the colouring matter of the urine, but he has shown, (what indeed was well known before,) that its normal quantity is liable to be much increased in general in phlogistic affections, and diminished in cases of debility and anaemia. He has also pointed out the often-observed fact, that in peculiar states of the colouring matters of the urine, the addition of nitric and muriatic acids (and occasionally of all acids,) changes the colour to various tints of red, purple, and lilac ; but he has not stated the pathological relations of these changes. I have frequently found these changes produced by acids in the urine in the incipient and middle stages of granular disease of the kidney ; but with the exception perhaps of one tint, (difficult to be described,) I do not consider them to be characteristic of that affection..

M. Becquerel regards the lactic acid as constituting the greater proportion of the indeterminate organic matters in the urine, and consequently as subject to the greatest variations in disease. He supposes it to exist in combination with urea, and with the alkaline bases of the urine ; but not in a neutralised condition. In general, deep coloured, heavy, and acid urine abounding in lithic acid and urea, contains the most lactic acid. Whether the pale coloured, light, and very acid urine occurring in certain states of disease, owes its acidity to lactic acid, M. Becquerel has not been able to determine. The presence of muriate of ammonia in the urine he takes for granted, without giving any experiments on the subject. We have already stated that Liebig calls these opinions of Becquerel in question ; and though he does not deny that lactic acid exists in diseased urine, he says that it is never found in healthy urine.

Of the inorganic principles and their compounds contained in the urine.—The proportion of fixed saline matters in the urine is liable to be much varied in different diseases. M. Becquerel has fixed the physiological limits of these changes between five and a half and eight parts in 1000 parts of urine ; and between $84\frac{1}{4}$ grs. and $124\frac{1}{2}$ grs. in twenty-four hours. The law of variation seems to follow nearly the law of variation in the quantity of urea formerly mentioned ; that is, the heavy, deep coloured, and scanty

urine of fever, &c., contains in 1000 parts a larger proportion of the fixed salts than in health ; while, from the small quantity of urine passed, the quantity actually secreted in twenty-four hours is much less than natural. When the quantity and specific gravity of the urine are normal, the proportion of fixed salts varies in general within the physiological limits ; but when the quantity of urine is large, even though the specific gravity be below the average, the quantity of fixed salts passed in twenty-four hours equals, but rarely surpasses, the average. On the whole, therefore, in a state of disease, with few exceptions only, the quantity of fixed salts passed in the urine scarcely reaches the average of health.

Besides the ingredients mentioned in the preceding pages as existing in healthy urine, this excretion in different diseases has been found to contain the following additional matters :

Albumen	} Of the chyle and blood.
Fibrin	
Red particles	
Nitric acid, and	
Various acids, &c., formed from or accompanying the lithic acid.	
Xanthic oxide.	
Cystic oxide.	
Sugar, oxalic acid, carbonic acid.	
Hippuric acid. Benzoic acid?	
Prussian blue. Cyanourine. Indigo.	
Bile. Cholesterine.	
Secretion of the prostate gland, &c.	
Seminal fluid.	
Pus, and perhaps other matters.	

On each of these principles we shall proceed to make a few remarks.

Albumen, fibrin, and the red particles, or hæmatosine, which constitute the great bulk of the matters existing in the blood, are

never met with in healthy urine. But in various diseases, the urine not only contains the serum of the blood, but the fibrin and red particles likewise pass through the kidneys, or are derived from other sources, so as to make their appearance in the urine. In certain diseases, the albuminous matters found in the urine more nearly approach those belonging to the chyle, than the blood, as formerly noticed.* In this case, the urine contains a considerable quantity of the oily principles, as well as of the imperfectly developed albuminous principles of the chyle. These imperfect albuminous matters have been sometimes confounded with *caseine* or *curd*—a principle, of the existence of which in the urine, I never could entirely satisfy myself.†

M. Becquerel has found the proportions of albumen to vary in twenty-four hours in different cases of scrous urine from 150 grs. to $3\frac{1}{2}$ grs.; and the proportion in 1000 parts of urine from nearly 12 parts to .114 part. The larger proportion occurs in general in the earlier and acute stages; the smaller in the chronic and latter stages.

Albuminous urine, on being exposed to a temperature of about 150° , becomes opake, and deposits this principle in a coagulated state. The precipitated albumen varies considerably in its appearance, in different instances. Sometimes it is of a firmer and more decided character, and similar to the precipitate formed by the serum of the blood more or less diluted. At other times, the precipitate is very delicate and fragile in its texture, and somewhat resembles curd; in which case it may be supposed to be of chylous origin. In estimating these different appearances, however, the *quantity* of the serum (i. e. the degree of dilution,) must be taken into account. In most instances, particularly when the urine is alkaléscent, the effects of heat on albuminous urine are increased by the addition of nitric acid. Indeed, for this reason, and from the phenomena sometimes presented by the phosphates, which, as before observed, are likewise precipitated by the applica-

* See page 112.

† Some have asserted, that the albuminous principle termed *Caseine* occasionally exists in the urine; but, as stated in the text, like M. Rayer, I have seen no instance of the presence of this principle in the urine. A fatty substance termed *Kiesel*, apparently allied to curd, is found in the urine of pregnant women. (See Med. Gazette, xxix. p. 505.) I have also found it mixed with the triple phosphate, in the urine of a delicate child, fed on milk.

tion of heat to the urine, the effect of heat should never be trusted to alone, when we wish to judge of the presence of albuminous matter in the urine.

Nitric acid, and various acid and other principles derived from the lithic acid, have been already alluded to, when speaking of lithic acid ; see page 542.

Xanthic oxide, (the *uric*, or *lithic oxide* of Liebig,) was first described by the late Dr. Marcet, who obtained it from a small calculus consisting of this substance nearly pure. This small specimen I saw and examined with Dr. Marcet ; but have never met with another specimen. Some late writers assert, that xanthic oxide forms a constituent of certain lithic acid calculi, of a light or bright brown colour ; and which exhibit a scaly shining fracture of a brown or deep flesh colour, and yield a resinous lustre by friction. I cannot confirm or deny this statement. Has the yellow colouring matter of the urine any relation to xanthic oxide ? Is the lithic acid liable to be reduced to the xanthic oxide by the fermentative process ? I have found a principle occasionally in fermented diabetic urine somewhat like xanthic oxide, but have not carefully examined it.

To obtain xanthic oxide from an urinary calculus containing it, we are directed to dissolve it in a solution of caustic potash, and to saturate the solution with carbonic acid. The xanthic oxide is precipitated white ; but on drying, forms a pale yellow mass ; which acquires a waxy lustre by friction. It is soluble in the pure and carbonated alkalies ; and sparingly soluble in hot water, muriatic and oxalic acids. It forms a deep yellow solution with strong sulphuric acid, and the addition of water does not cause a re-precipitation. Nitric acid dissolves it without effervescence, and on evaporation there is left a residuum, which, instead of possessing the purple colour yielded by lithic acid under similar treatment, is of a *lemon yellow* colour—a property from which it derives its name. Xanthic oxide is said by Liebig to differ from lithic acid, by containing one proportion less of oxygen.

Cystic oxide.—This substance is peculiar to the urine, and sometimes forms whole calculi. In the form of calculus it may be said to be rare ; but I have reason to believe that its existence in the urine, in certain states of disease, is not a very uncommon

occurrence. Cystic oxide may be distinguished by its solubility in alkalies and most acids; and by the characteristic odour it yields when burnt. It is, however, very little soluble in acetic acid; hence, when cystic oxide exists in the urine, it may be readily precipitated from that fluid by vinegar. I analysed this substance many years ago, and the analysis has been lately confirmed in all respects, except that one half of the matters which I *estimated* to be oxygen, has been proved to be sulphur. I had long suspected that this curious substance contained another principle besides the four usual constituents of organic products; and was about to verify my conjecture, when I heard of the above discovery. I suspected the presence of phosphorus rather than of sulphur. The cystic and xanthic oxides are doubtless of albuminous origin.*

Sugar is not found in the blood in a state of health, but has been many times distinctly recognised in the blood of diabetic individuals; where it probably always exists in a greater or less degree. Sugar, also, is not a natural ingredient of the urine, but is found in large quantities in that fluid, in the disease just mentioned. I am not aware that sugar has ever been found in the blood, or even in the urine, of any inferior animal; which may be considered a remarkable circumstance. The sugar of diabetic urine differs in its appearance from common sugar, and approaches in its properties more nearly to the *low* sugar of grapes. Urine containing sugar (and albumen) exerts a peculiar action on polarised light. Hence this property has been proposed by Biot to detect the existence of sugar in the urine, and consequently the presence of diabetes.

In incipient cases of diabetes, I have several times found mixed with the sugar in various proportions, and in one or two instances existing *alone*, a peculiar intermediate principle, allied to sugar, but incapable of, or at least not readily running into, the vinous fermentation. I have kept such urine unchanged for months in a warm room; at the end of which time it has occasionally begun to change, and at length become acid, apparently

* Cystic oxide is composed of 5·10 hydrogen, 30·01 carbon, 28·38 oxygen, 11. azote, and 25·51 sulphur.

by the development of lactic acid, but without the formation of alcohol. The presence of a large quantity of sugar in the urine may, for the most part, be readily discovered by the sweet taste it imparts to the urine ; when in small quantity, the presence of sugar in the urine may be detected by heating the urine with about one half its bulk of *liquor potassæ*. The mixture should be boiled together for two or three minutes, when if sugar be present, a deep coloured molasses is formed. This, which is one of the easiest tests of sugar, was first proposed by Mr. Moore, of Birmingham.

Trommer's test for sugar. A small quantity of a solution of the sulphate of copper, just sufficient to tinge the urine blue is to be added to the suspected urine in a test tube. *Liquor potassæ* is then to be added in excess till the urine becomes clear. Apply heat to boiling ; when a deposit of the red oxide of copper will be precipitated if sugar be present. Other tests for sugar have been lately proposed, but the above are quite sufficient for all practical purposes.

Urine containing sugar is generally pale-coloured ; has a specific gravity above 1.030, and its natural ingredients are often relatively diminished in quantity.

Oxalic acid; Oxaluric acid.—Oxalic acid is neither found in the blood nor in the urine in a state of health ; but in certain forms of disease probably exists in both fluids. Oxalic acid is usually found as a urinary product in conjunction with lime, and forming the oxalate of lime or mulberry concretion. The affinity of oxalic acid for lime is such, that it takes this earth from all its forms of solution. Hence the exact state in which the oxalic acid exists in the blood, and at the first moment of its separation from that fluid, is little known ; though most probably it is in a state of combination either with urea or with ammonia.* The oxalate of lime appears in some rare instances as gravel ; sometimes in the form of minute octohædral crystals, mixed with the lithate of am-

* Oxalic acid is said to pass through the system unchanged, and to occasionally appear in the urine of those who have taken freely of sorrel, rhubarb, tomatoes, &c., which contain this substance. I have reason to believe also, that the free use of the *liquor potassæ* occasions the development of oxalic acid in some individuals.

monia amorphous sediment; but generally, as above mentioned, in the form of concretions.*

I have seen two instances, and in a less marked degree a third instance, in which the oxalate of lime was passed in the crystallised form in such abundance, that a tea-spoonful or more of large well-defined octohædral crystals could be collected in a day or two. In these cases the urine was transparent, and corresponded (together with the symptoms) in all respects with the description given at page 62 of this volume. The oxalate of lime is sometimes found in the amorphous form in calculi chiefly composed of the lithate of ammonia from children. In certain forms of severe dyspepsia, also, usually indicated by urine of high specific gravity, and depositing large quantities of the lithate of ammonia, the oxalate of lime is found intermixed with the lithate of ammonia; but always in small proportion compared with that compound. Such mixtures may be detected by heating a little of the turbid urine, or adding to it a little *liquor potasse* so as to dissolve the lithate of ammonia, when the oxalate of lime may be seen in the form of minute octohædrons by the aid of a high magnifier, or by a microscope, as has been pointed out by Dr. Golding Bird; though the fact, (first accidentally noticed under the above circumstances,) has been long familiar to me. Such cases, from the great predominance of lithic acid, I have always regarded as belonging to the lithic acid category rather than to the oxalate of lime; for during the long attention I have paid to urinary diseases, I have very rarely seen such cases accompanied by, or terminating in the formation of a mulberry calculus. On the other hand, I may state it as a fact equally remarkable, that in comparatively few instances only, either by the microscope or by chemical means, have I detected the oxalate of lime in the urine of those occasionally passing calculi of the oxalate of lime; and in whom the oxalic diathesis obviously existed in the most marked degree. I can scarcely explain this circumstance, though somewhat similar phenomena take place with regard to lithic acid. In the most exquisite form of this diathesis, accompanied by a very strong tendency to urinary calculi, the urine is generally transparent, of moderate specific gravity, and comparatively free from lithic acid. When the oxalic acid is found in connexion with a large proportion of lithic acid, it may be immediately formed by the decomposition of the lithic acid; but in the oxalic acid diathesis properly so called, in which the lithic acid is absent, the oxalic acid has probably an immediate reference to the saccharine radical. It is not improbable that the modification of oxalic acid termed the oxaluric acid, occasionally exists in the urine. It has been lately stated, that the oxalic acid is evolved from the lithic acid, &c. after the urine is voided. I have made many observations on this point under the most favourable circumstances, but never could satisfy myself of its accuracy. That the lithic acid under certain circumstances is convertible into the oxalic acid, or something mistaken for it, was known to the earlier chemists; and I have myself been aware of the fact ever since I have been acquainted with lithic acid.

Oxalate of lime, when burnt, yields quick lime ; or if the salt be boiled with an excess of sulphuric acid, the oxalic acid may be separated, and thus readily distinguished by its properties. The oxalate of lime also, even when newly precipitated, is insoluble in acetic acid, by which property it may be readily distinguished and separated from the earthy phosphates.

Carbonic acid was long ago stated to exist in the urine, but the fact was called in question by Berzelius. Some experiments, however, of Dr. Mareet rendered it probable that under certain circumstances carbonic acid exists in that fluid ; and I have myself very frequently met with this acid in the urine. Moreover, we stated, that the earthy phosphates are sometimes held in solution by carbonic acid ; and that small calculi composed of the carbonate of lime are occasionally voided from the bladder. The carbonic acid in the urine is probably most frequently derived from the decomposition of urea, which, as we have stated, is readily converted into the carbonate of ammonia when water is present. According to some also, though others have denied the circumstance, carbonic acid occasionally passes through the system, and may be detected in the urine of many individuals who drink freely of soda water, &c. The existence of free carbonic acid may be shown by placing the urine under the receiver of an air-pump, with lime water, in the manner described by Dr. Mareet.*

Benzoic acid. Hippuric acid.—Benzoic acid was formerly stated by Scheele to exist in the urine of children ; but this statement is doubted by Berzelius ; and I think with great reason ; as I have never met with an instance of its occurrence. Liebig, moreover, has shown that what was formerly considered as benzoic acid, is in reality a new acid, to which he has given the name of *Hippuric acid* ; from its abounding in the urine of the horse. The hippuric acid, however, is not confined to the urine of the horse, but is found in the recent urine of many herbivorous animals, in combination with soda.† Hippuric acid was formerly said to exist in the urine of young children, and Liebig has recently obtained it from human urine in its healthy state.‡ Hip-

* *Essay on Calculous Disorders*, page 159, first edition.

† *Ann. de Chimie et de Physique*, xlivi. page 188.

‡ M. Wittstock is said to have found hippuric acid in diabetic urine.

puric acid may be obtained from the urine in which it exists, by adding muriatic acid after the urine has been concentrated by evaporation. The hippuric acid is separated in the form of long transparent four-sided prisms, more soluble in warm water than in cold, and soluble in alcohol.*

Prussian blue; Cyanourine. Indigo.—A substance supposed to be Prussian blue has been met with in some rare instances in the urine.† Braconnot has also described a substance, under the name of *cyanourine*, occasionally found in the urine, and which sometimes tinges it blue. From its properties, this substance appears to be nearly allied to certain vegetable blues; and hence it may, as Dr. Rees has observed, be probably derived from some vegetable matters taken as food.‡ I once met with an instance in which indigo was occasionally voided in the urine, in considerable quantity. The patient was a middle-aged man of a nervous temperament. He was in the habit of taking Seidlitz powders; and the indigo most generally appeared in the urine, in the form of a dark blue sediment, after taking one of these powders. The quantity was so considerable on one occasion, as

Wöhler, Berzelius's Jahresb. vi. 283. Mr. Ure has observed that when benzoic acid is taken into the stomach, hippuric acid is found in the urine. He at first supposed the hippuric acid to be derived from the decomposition of lithic acid; but it most probably depends on some other change not at present understood, produced by the benzoic acid, on one or more constituents of the urine. Med. Chirurg. Trans. vol. vi. p. 30, second series. See also page 239 of the present volume.

* The following table contains the analyses of various forms of sugar and oxalic acid, &c. Also of benzoic and hippuric acids.

	Hydrogen.	Carbon.	Oxygen.	Azoto.
Diabetic sugar	7·07	36·36	56·57	
Sugar of milk	6·66	40·00	53·33	
Cane sugar .	6·43	42·10	51·47	
Lignine .	6·17	44·44	49·39	
Oxalic acid c.	4·76	19·05	76·19	
Benzoic acid .	4·36	74·7	20·94	
Hippuric acid	4·959	60·742	26·483	7·816

† See Nov. act. Nat. Cur. viii. obs. 21. Also Archives Gen., Mai, 1823.

‡ Rees on the Analysis of the Blood and Urine, p. 81.

to allow of its being collected and examined ; when it was found to possess all the properties of indigo, and was obtained in a state of purity by sublimation. I had expected to find it consist of Prussian blue.

Bile. Cholesterine.—In certain diseases, and particularly in jaundice, the bile makes its way, not only into the blood, but into the urine. Urine containing bile, when examined in considerable quantity, and viewed by transmitted light, is generally of a deep brownish-red colour. But in small quantity, urine containing bile, has sometimes a yellowish-green appearance. A piece of white linen is well known to be stained yellow by biliary urine ; and the addition of muriatic acid renders it green. This green colour sometimes appears almost immediately ; sometimes not for many hours ; and in a few instances, not at all. If the green precipitate occasionally formed by the addition of muriatic acid ; and the yellow precipitate sometimes occurring naturally in biliary urine, be soluble in potash ; or, on being treated with nitric acid, pass through the various shades of blue, violet, and pink, formerly mentioned as displayed by the colouring matter of the bile, the presence of bile in the urine is distinctly indicated. Various other tests have been proposed, but the above are sufficient for practical purposes. In organic affections of the kidney and liver, I have occasionally seen in the urine a crystallised fatty substance, similar to that frequently met with in encysted tumours, and various malignant affections, and which has been considered as cholesterine by Caventou, Breschet, Dr. Christison, and others.* Chylous urine contains fatty matter in great abundance, and some modern chemists have asserted, that the urine always contains a little oily or resinous matter. Dr. F. Keller has lately described a substance of this kind which he has called *urostealith*. It has been found in a single instance only.†

Secretion of the Prostate Gland.—In certain diseases of the prostate gland, or when that gland has, from any cause, been irritated, large quantities of its peculiar secretion are occasionally formed and appear in the urine. This secretion is sometimes but little changed ; at other times its properties are considerably mo-

* M. Breschet in the article “*Calcul*,” of the *Nouveau Dictionnaire de Médecine*.

† Keller’s Archives, 1845.

dified. In general, this secretion may be distinguished from mucus, by its marked albuminous properties; and by its peculiar appearance. This appearance, however, can hardly be so described as to be made intelligible to those who have not attended to urinary phenomena.

The *seminal fluid* is also found in the urine in abundance, so as to constitute a disease called *spermatorrhœa*. It is frequently present when the oxalate of lime abounds in the urine, but not always, as has been asserted. The presence of the seminal fluid may be always detected by the microscope, which shows the animalcules by which it is distinguished. See plate III.

Pus occasionally appears in the urine in great abundance, so as to render its presence unequivocal. When present in the urine in large quantity, and unaccompanied by mucus; or when mixed with blood, pus in general may be supposed to be derived from an abscess. Most frequently however, pus is accompanied by mucus. Indeed, mucus and pus (or something so like pus as to be with difficulty distinguished from it) seem to be nearly related, and to run into each other by imperceptible grades; and when the mucus is in excess, or has preceded the pus, we may almost always conclude that some portion of the mucous membrane lining the urinary organs is the common source of both deposits. A great deal of pains has been taken to point out some chemical test which may enable us to distinguish mucus from pus; but I am not acquainted with any entirely free from objection. Pus, however, when well marked, may be distinguished from mucus by being essentially composed of *particles*, easily separable from each other.* Hence, when diffused through the urine, which it readily may be, pus after a time again subsides to the bottom of the vessel, in the form of a pale greenish-yellow pulverulent deposit; and the urine assumes its transparent character; properties by which pus are strikingly contrasted with mucus. Urine containing pus is also almost invariably albuminous, another property by which purulent urine is contrasted with urine merely contain-

* The subject of pus has been recently much elucidated by Mr. Gulliver, to whose papers the reader is referred for further information on the subject. The microscopical appearance of pus has been already noticed. See page 182 *et seqq.*, also plate III.

ing mucus. A third circumstance by which pus and mucus are strongly opposed, consists in the character of the urine. Urine containing pus, particularly when of low or moderate specific gravity, is very often acid, and has little tendency to become alkaline; on the contrary, urine containing much mucus, if not alkaline when passed, speedily becomes alkaline and putrescent. Lastly, pus usually contains a little oily matter, which mucus does not.

The effects of alkalies on pus, I believe, were first pointed out by Mr. Cruickshanks,* and these effects are occasionally of considerable importance in a pathological point of view. Thus urine containing both pus and mucus, sometimes becomes alkaline; and the ammonia evolved converts the pus into a peculiar glairy substance, which imparts to the urine aropy consistence. This phenomenon, which is not very common, always denotes the presence of a purulent secretion, as well as disease of a mucous membrane, as has been recently noticed by Dr. Babington.† I have, however, been acquainted with the fact for many years; which as above stated, seems to have been first pointed out by Mr. Cruickshanks.

Lastly, minute *hairs* have occasionally been found in the urine. These, in many instances, have probably been derived from some external source; though I have repeatedly seen hairs in the urine, where it was difficult to account for their presence in this manner: and once I met with detached hairs in the pelvis of the kidney after death. I have recently seen an instance of a small calculus passed from the bladder, the nucleus of which was a collection of hairs.

Besides the preceding substances, a great many others have been occasionally found in the urine, and consisting of matters which had been taken by the mouth, and passed through the system but little changed. Such, for instance, is the hydriodate of potash, which may be detected in a very short time, in the urine of those who have taken it, by the aid of a solution of starch, and a few drops of nitric acid. Other saline matters said to pass through the urine but little changed, are the borate of soda, the alkaline carbonates, the chlorate of potash, the prussiate

* Thomson's Chemistry, iv. p. 584, sixth edition.

† Guy's Hospital Reports, vol. iii.

of potash, the nitrate of potash, the muriate of barytes, &c. &c. On the contrary, the mineral acids, the preparations of bismuth and lead, the oxide of iron, &c., are said by Berzelius and Wöhler not to pass through the kidneys. Among substances of an organic origin, some pass through the system readily, and appear in the urine, while others are decomposed. Of substances passing more, or less readily through the system, may be mentioned the gallic acid, (as in the *uva ursi*, &c.,) also the succinic acid, the carbonic acid ? &c. According to some, the uncombined citric, malic, and tartaric acids pass through the kidneys; but this is denied by others, and I think with good reason; at least in a healthy condition of the assimilating organs and kidneys. When combined with alkalies most of the vegetable acids are readily decomposed in their transit through the system.

To the list of substances passing through the system as far as to impart to the urine their peculiar odour, more or less modified, may be added various essential oils and balsams, as turpentine, copaiba, and many others of this class; also the aromatic and colouring principles of coffee, onions, asparagus, &c. With respect to this last class of substances it may be remarked, that the phenomena take place much more readily in dyspeptic, than in healthy individuals. Indeed the odour of almost everything taken may be detected in the urine of dyspeptic and sedentary persons; and the circumstance may be considered as invariably denoting imperfect assimilation.

The following general inferences may be drawn from the details stated in this volume.

First. The liver is the organ by which the blood is depurated of the unassimilated and superfluous oleaginous matters; as well as of those portions of the blood deprived of its azote, of its saccharine constituents, and consequently of its vitality, during the primary assimilating processes.

Secondly. The kidneys are the organs by which the blood is depurated of the unassimilated, superfluous, and effete albuminous

principles, as well as of the mineral matters incidental to these principles, or which are otherwise derived.

Thirdly. The neutral and alkalescent characters of the bile, and the oxygenated and acidulous characters of the urine, show that the general character of the actions going on in the liver and the kidneys are directly opposed to each other—in short, that the general action of the liver is of a negative, the general action of the kidneys of a positive character; and that one of these two important organs thus antagonistically related to each other, cannot be deranged without deranging the other.*

Fourthly. The liver and the kidneys (as well as certain minor glandular apparatus) either in virtue of the polar arrangements, above mentioned, or of some other (vital) property, must, in a state of health, possess the *function of selecting* from the blood those peculiar principles adapted for their respective operations; and of producing such further changes in them as the animal economy may require. The changes produced by the liver on the principles to be eliminated by that gland, are in some degree of an organising kind; that is, the principles separated retain some of their vitality for ulterior purposes; while the changes produced by the kidneys on the principles designed to be removed from the system by these glands, are, in a state of health, without exception, of a disorganising kind—that is, everything passed from the kidneys is denuded of its vitality, which is carefully retained as it were in the system. The liver, therefore, may be said to possess an *organising*, the kidneys a *disorganising function*. This deduction is illustrated by what takes place in diseases of the liver and kidneys. Thus, when the liver is diseased, its selecting and organising functions are impaired or lost; and instead of selecting, and further changing into bile those principles, which the welfare of the economy requires should be removed from the blood and employed elsewhere, such principles are retained in the system; or if they do pass through the liver and are separated by that organ, they are imperfectly adapted for their ulterior functions;

* This deduction may be stated still more generally thus:—the liver may be considered as the principal focus or *pole* of all the negative, the kidneys as the principal focus or *pole* of all the positive, actions going on throughout the organic system.

and thus in both ways great derangements of the health are the consequence. Again, when the kidneys are diseased, their selecting and disorganising functions are impaired or lost; and the deleterious principles in the blood, (*e.g.* the urea and lithic acid,) are no longer selected in preference for separation from that fluid; while the superfluous or effete albuminous principles, which in the healthy kidney would have been selected and converted into the lithate of ammonia, either remain in the blood, or pass through the kidneys unchanged.

These inferences, duly understood and applied, will explain a great many of the phenomena of animal bodies, both in health and in disease.

Of Urinary Calculi.

It remains, in the last place, to describe briefly the different forms assumed by urinary concretions.

From various causes elsewhere considered, the principles described in the preceding section, as existing in the urine, in health and in disease, concrete together into solid masses, and form what are denominated *urinary calculi*. Urinary calculi vary much in their appearances and chemical composition; but the more important varieties may be comprised under the following species :

- a. *The lithic acid calculus.*
- b. *The lithate of ammonia calculus.*
- c. *The oxalate of lime calculus.*
- d. *The cystic oxide calculus.*
- e. *The bone earth, or phosphate of lime calculus.*
- f. *The triple phosphate of magnesia and ammonia calculus.*
- g. *The fusible calculus; or the calculus composed of a mixture of the phosphate of lime and of the triple phosphate of magnesia and ammonia.*

- h. The alternating calculus (comprising numerous varieties.)*
- i. The mixed calculus.*
- k. The carbonate of lime calculus.*
- l. The xanthic oxide calculus.*
- m. The fibrinous calculus.*
- n. The prostatal calculus.*

a. The lithic acid calculus is generally of a brownish-red or fawn colour; but occasionally approaches the colour of mahogany. Its surface is commonly smooth; but sometimes finely tuberculated; and on being divided, it is usually found to consist of concentric laminæ. Its fracture generally exhibits an imperfectly crystallised texture; and in this case it is nearly pure; at other times, the fracture is earthy or amorphous, when it usually contains a mixture of other ingredients. The lithic acid is the most common species of calculus, and occurs of all sizes, from a grain or two to five or six ounces, or more. Its shape also is very various; but in general it is more or less ovoid.

b. The lithate of ammonia calculus is generally of a clay colour. Its surface is sometimes smooth, sometimes slightly tuberculated. It is composed of concentric layers, and its fracture is very fine earthy, resembling that of compact limestone. This form of calculus seems to be principally confined to children under puberty, and hence is generally of small size and rather rare.* It often

* Med. Chirurg. Trans. vol. x. page 389.

a. Chemical properties.—Before the blow-pipe, the lithic acid calculus blackens, emits a smoke having a peculiar odour, and is gradually consumed, leaving a minute quantity of white ashes, which are usually alkaline. Lithic acid is completely soluble in a solution of caustic potash, from which it may be precipitated again by any acid, in the form of a white granular powder. Lastly, if to a small particle a drop of nitric acid be added, and heat applied, the lithic acid is dissolved; and if the solution be evaporated to dryness, the residue assumes a beautiful pink or carmine colour.

b. Chemical characters.—The lithate of ammonia in many of its properties resembles the lithic acid calculus. Before the blow-pipe, however, it frequently decrepitates, particularly when mixed with other matters. It is much more soluble in water than the lithic acid calculus, and always yields a strong smell of ammonia when heated with caustic potash. The lithate of ammonia is also readily soluble in the alkaline subcarbonates.

contains a mixture of other matters in various proportions, and particularly of the oxalate and lithate of lime, and small quantities of the phosphates.

c. *The oxalate of lime or mulberry calculus*, is generally of a deep-brown colour, sometimes approaching to very dark olive-green or black. Its surface is very rough and tuberculated, (hence the epithet *mulberry*.) It is usually hard, and, when divided, exhibits a more or less perfectly laminated texture. This species of calculus seldom surpasses the middle size, and is rather common. There is a variety of it remarkably smooth and pale-coloured, and usually containing a mixture of the lithate of ammonia. Such calculi are always of small size; and, from their colour and general appearance, have been termed the *hemp-seed* calculus. There is also another variety, consisting of the oxalate of lime nearly pure, and in a crystallised form. This variety, which is not common, is very rough; and usually presents numerous sharp angular facets. Its colour varies, but is occasionally quite white.

d. *The cystic oxide calculus* is of a yellowish white colour, and its surface, which is commonly smooth, exhibits a kind of crystallised appearance. The colour of this calculus has been noticed by Dr. Golding Bird to undergo a remarkable change, and to assume a blueish-green tint. I have not seen an instance of this change, though I have specimens which have been many years in my possession. This change has been supposed to depend on the sulphur contained in the calculus.* When broken, the cystic oxide calculus is rarely found to consist of distinct laminæ, but appears as one mass confusedly crystallised throughout its substance. The fracture exhibits a peculiar glistening lustre like that

* See Guy's Hospital Reports, vol. vii., p. 200.

c. *Chemical characters*.—Before the blow-pipe, this species of calculus expands into a kind of white efflorescence, which when moistened and brought into contact with turmeric paper, stains it red. This white alkaline substance is the caustic lime of the calculus, deprived of its oxalic acid. The oxalate of lime may be also distinguished from the phosphates, by being nearly insoluble in acetic acid, even when newly precipitated.

d. *Chemical characters*.—This calculus yields a very peculiar and characteristic odour when exposed to the flame of a blow-pipe. It is also very readily soluble both in acids and alkalies.

of a body having a high refractive density; and when in small fragments, it is semi-transparent. This calculus is small; or seldom surpasses the medium size, and is very rare.

e. *The bone earth or phosphate of lime calculus* is generally of a pale-brown colour, and its surface is frequently smooth like porcelain, so as to appear highly polished. When sawn through, it is found very regularly laminated, and the laminae easily separate from each other. These laminae are often striated in a direction perpendicular to the surface; as from an assemblage of fibres. This species of calculus has not hitherto been observed of large size, and is not common. It seems also to be more usually formed in cysts or cavities, than of urinary origin.

f. *The triple phosphate of magnesia and ammonia calculus* is always nearly white; its surface is commonly uneven, and covered with minute shining crystals. Its texture is not laminated; and it is easily broken and reduced to powder. In some rare instances, however, it is hard and compact; and when broken, exhibits a crystallised texture, and is more or less transparent and laminated. Calculi composed entirely of the triple phosphate of magnesia and ammonia, are unusual; but specimens in which this salt constitutes the predominant ingredient are very common.

g. *The calculus composed of a mixture of the phosphate of lime, and the triple phosphate of magnesia and ammonia, or the fusible calculus*, is commonly whiter and more friable than any other species; and sometimes leaves a white dust on the fingers, like a mass of chalk. This species is usually not lami-

e. *Chemical properties.*—This species of calculus differs in its properties according to the proportions of its constituent principles. In general, it fuses with difficulty, or is quite infusible, before the ordinary blow-pipe. It is readily dissolved by muriatic acid, and reprecipitated from its state of solution by pure ammonia without decomposition, most usually in the form of a white uncryallised powder.

f. *Chemical properties.*—Before the heat of the blow-pipe this calculus gives off the odour of ammonia, and at length melts with difficulty. It also gives off ammonia when treated with caustic potash. It is much more soluble than the preceding species in dilute acids, from which it is again readily precipitated by ammonia in its original crystallised form.

g. *Chemical properties.*—This species of calculus readily melts before the

nated. Occasionally, however, the mass of the calculus readily separates into thin laminæ, the intestices of which are often studded with sparkling crystals of the triple phosphate. The variety of this species which is not laminated often acquires a very large size, and assumes the form of a friable white mass, evidently moulded to the contracted cavity of the bladder, or other part in which it has been formed. This species of calculus occurs very frequently.

h. The alternating calculus, as the name imports, may consist of different layers of any of the preceding species. Hence its general appearance, texture, &c., will depend entirely on its composition; and may be very various. Most commonly the alternating calculus consists of a nucleus of lithic acid, lithate of ammonia, or oxalate of lime, (or a mixture of all three of these substances, as well as of the lithate of lime, and other matters,) and an external crust of the fusible calculus. In some instances the alternating calculus may consist of three or more laminæ of these and other substances—the mixed phosphates still continuing to constitute the external crust. This species of calculus often attains a large size, and is very common.

i. Mixed calculi are generally of small size, and are most frequently found in early life; hence they constitute the nuclei of other calculi. The mixture may consist, as just stated, of the blow-pipe, and hence the epithet—*fusible calculus*. It also dissolves readily in acids, and particularly in dilute muriatic acid; and if to the solution (not too acid) the oxalate of ammonia be added, the lime is precipitated alone; and the magnesia may be afterwards separated by the addition of pure ammonia. This calculus almost always contains, besides the mixed phosphates, a little carbonate of lime and animal matter.

h. Chemical characters.—The chemical characters of the alternating calculus of course vary with the composition; and as the different substances must be some of the simple substances before described, the nature of the different laminæ can be easily ascertained from what has been already stated.

i. Chemical properties.—The characters of mixed calculi are of an ambiguous nature, and vary with their composition. The following brief summary will enable us to detect the composition of the most frequent varieties:

Mixtures of the lithate of ammonia, oxalate of lime, and the phosphates, may be thus detected and separated. Boil the powdered calculi in distilled

lithic acid, the lithates of ammonia and of lime, oxalate of lime, and sometimes the mixed phosphates. Their sensible properties of course will vary with their composition; but usually mixed calculi assume more or less of the characters of the predominant ingredient, which, generally speaking, may be considered as either the lithate of ammonia, or the oxalate of lime. In one sense of the term, all calculi may be said to be *mixed*; but calculi of considerable magnitude, and consisting of a mixture of pure ingredients in large proportions, as of pure lithic acid, with the phosphates, &c., are very unusual, or rather do not exist; at least I have seen no such calculi.

k. Carbonate of lime calculus.—I have seen some small calculi composed almost entirely of this salt. They were perfectly white, and very friable. Mr. Smith has described others which closely resembled in appearance the mulberry calculus.* This species of calculus is very uncommon; though, as we have stated, the carbonate of lime is frequently found in small proportions in phosphatic calculi.

l. The xanthic oxide calculus has been already described.† water. This takes up the lithate of ammonia, and leaves the oxalate of lime and phosphates. The residuum may be then treated by dilute acetic acid, which takes up the triple phosphate, and leaves the phosphate and oxalate of lime. If to the solution in acetic acid ammonia be added, the triple phosphate of magnesia and ammonia may be obtained; the lithic acid may be then removed from the residuum by a solution of caustic potash; and after incineration, the lime (representing the oxalate) and phosphate of lime may be separated in the usual manner.

Mixtures of the lithate and oxalate of lime may be thus detected and separated. Boil the mixture in dilute muriatic acid, which decomposes the lithate of lime, dissolves the lime and oxalate of lime, and leaves the lithic acid. Add ammonia to the solution, which precipitates the oxalate of lime; while the remaining lime may be finally precipitated by the addition of the oxalate of ammonia. By varying these and similar processes according to circumstances, other combinations still more complicated may be detected and separated.

k. Chemical characters.—The carbonate of lime may be readily detected by its effervescing with muriatic (and other) acids; while the lime, after the acid has been nearly neutralised with ammonia, may be precipitated by the oxalate of ammonia.

* Med. Chirurg. Trans., vol. ix. p. 14.

† See pages 238 and 562.

I have never seen any other specimen than that noticed by Dr. Marcket; though, as formerly stated, this principle has been recognised in mixture with lithic acid in some instances.

m. The fibrinous calculus, first described by Dr. Marcket, has all the properties of the fibrin of the blood, of which it undoubtedly consists.* Such concretions, of which I have seen several instances, are usually of an amber-colour and waxy consistence, and have more or less of a fibrous texture; in short, their properties differ so much from any substance of urinary origin, that their nature, when they occur, can hardly be mistaken.

There is another species of calculus, which, though not of urinary origin, is very liable to be mistaken for such, from the situation in which it is found, viz.

n. The prostatal calculus.—Of this species of calculus there seem to be two varieties. The first variety is usually found in the natural cavities of the gland, before it becomes much disorganised. This variety is of small size, more or less rounded in shape, and of a yellowish-brown colour. The second variety seems to be generally formed in an enlarged cavity or abscess of the prostate gland; where it is sometimes met with in great numbers. This variety is usually of much larger size than the other, and sometimes has a highly-polished porcelaneous appearance. The composition of both, however, is nearly the same—that is, they consist chiefly of the phosphate of lime, a little carbonate of lime, and animal matter. In different instances, the relative proportions of the phosphoric acid to the lime and the carbonate of lime, appear to vary considerably. Prostatal calculi, however, can seldom be mistaken for calculi of urinary origin; the phosphate of lime being, as we have said, very rarely if ever deposited alone from the urine, so as to form urinary calculi.

There are several other varieties of urinary calculi, most of which consist of rare combinations or admixtures of the preceding ingredients. For an account of these, as well as a more detailed account of the chemistry of urinary concretions, the reader is

* See an Essay on the Chemical History and Medical Treatment of Calculous Disorders, by Alex. Marcket, M.D.

referred to the able translation of M. Scharling's Essay on the chemical discrimination of vesical calculi, by Dr. S. E. Hoskins. Also to Dr. Golding Bird's observations on urinary concretions and deposites; with an account of the calculi in the museum of Guy's Hospital, in the Guy's Hospital Reports, vol. vii. p. 175.

APPENDIX.

**CONTAINING TABLES, ILLUSTRATING THE NUMBER OF FATAL
CASES FROM DIABETES AND CALCULUS, IN DIFFERENT DISTRICTS OF
ENGLAND AND WALES;**

THE COMPARATIVE PREVALENCE,

**AND LAWS OF FORMATION AND ALTERNATION OF
DIFFERENT CALCULOUS DEPOSITES;**

**THE COMPARATIVE PREVALENCE OF CALCULOUS AFFECTIONS AT
DIFFERENT AGES, AND IN THE DIFFERENT SEXES;**

AND THE

RATE OF MORTALITY FROM THE OPERATION OF LITHOTOMY

